Cedar Lake and McMahon (Carl's) Lake Total Maximum Daily Load Implementation Plan

Prepared by the Scott Watershed Management Organization

May 2012

A Portion of the Funding Provided by the Minnesota Pollution Control Agency Clean Water Partnership Program

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Executive Summary

Cedar Lake and McMahon (Carl's) Lake (DNR IDs 70-0091 and 70-0050, respectively) are currently listed on the Minnesota Pollution Control Agency's (MPCA) 2008 303(d) Impaired Waters List due to excessive nutrients (phosphorus). Both lakes are located in the lower portion of the Minnesota River Basin (Figure 1) and lie within the North Central Hardwood Forest Ecoregion. A Total Maximum Daily Load (TMDL) Report was completed for Cedar Lake and McMahon Lake in January 2010.

Cedar Lake is one of the largest lakes in Scott County with a surface area of 779 acres, a maximum depth of approximately 13 feet, and a mean depth of 6.9 feet. Cedar Lake receives diverted flow from a tributary to Sand Creek via an inlet structure in addition to inflows from the direct watershed. McMahon Lake is a shallow lake with a surface area of 130 acres and maximum and mean depths of 14 feet and 8.5 feet, respectively. McMahon Lake lies within an enclosed watershed receiving runoff only from the direct watershed.

Phosphorus load reductions to Cedar Lake and McMahon Lake will be achieved by targeting both watershed and in-lake (internal) sources. The Implementation Plan for Cedar Lake and McMahon Lake is multi-faceted, with various projects put into place over the course of many years. This adaptive management approach allows for monitoring and reflection on project successes and the chance to change course if progress is exceeding expectations or is unsatisfactory. The Scott Watershed Management Organization (WMO) is taking the lead on implementing the projects described in this plan, with the support of Minnesota Pollution Control Agency and local entities within the watershed.

Management practices for both lakes include curlyleaf pondweed treatment, sediment phosphorus inactivation, and external watershed treatments. Cedar Lake presents a challenge with its carp population since managing carp is still an emerging science. However, a strategy for reducing rough fish populations is included in the plan. Likewise, McMahon Lake in addition to curlyleaf pondweed, has Eurasian watermilfoil, and thus the plan includes contingencies for controlling the spread of Eurasian watermilfoil as water clarity improves.

For Cedar Lake the estimated cost is from $1,390,000 to $2,430,000; and for McMahon the cost range is from $271,100 to $456,100. The total cost for implementation of the projects described in this TMDL report is expected to range from $1,661,100 to $2,891,100 (2010 dollars).

Section 1.0: Introduction

Cedar Lake and McMahon (Carl's) Lake (DNR IDs 70-0091 and 70-0050, respectively) are located in the lower portion of the Minnesota River Basin (Figure 1-1) and are located within the North Central Hardwood Forest (NCHF) ecoregion. McMahon (Carl's) Lake lies within an enclosed watershed receiving runoff only from the direct watershed, while Cedar Lake receives flow diverted from a tributary to Sand Creek via an inlet structure, in addition to inflows from the direct watershed. The diversion structure outlets into the lake at Cedar Lake Farm, a 300 acre regional park located on the southwest side of the lake.

Cedar and McMahon Lakes are currently listed on the Minnesota Pollution Control Agency's (MPCA) 2008 303(d) Impaired Waters List due to excessive nutrients (phosphorus) and require a Total Maximum Daily Load (TMDL) report. The lakes were first listed on the MPCA's 303(d) list in 2002. The TMDL reports for both lakes have a target start date of 2008 and a target completion date of 2012.

Table 1-1. Cedar Lake and McMahon Lake 10-Year Average Water Quality Parameters

Water Quality Parameter	MPCA Shallow Lake Eutrophication Standards		Cedar Lake 10-year (1999-2008) Growing Season (mid-May through Sept.) Average	McMahon Lake 10-year (1999-2008) Growing Season (mid-May through Sept.) Average
	Western Corn Belt Plains	North Central Hardwood Forests		
Total Phosphorus (µg/L)	90 µg/L	60 µg/L	170 µg/L	85 µg/L
Chlorophyll *a* (µg/L)	30 µg/L	20 µg/L	71 µg/L	70 µg/L
Secchi disc (m)	0.7 m	1.0 m	1.28 m	0.88 m

Cedar and McMahon lakes are also located within 10 to 15 miles of the boundary of the Western Corn Belt Plains (WCBP) ecoregion. The Scott WMO is not convinced that NCHF ecoregion standards are appropriate for Cedar Lake. In the future, it may be appropriate to consider applying the standards for the WCBP ecoregion provided beneficial uses are met, and at that time a request for a site-specific standard would be expected to be made to the MPCA and the U.S. Environmental Protection Agency (EPA).

This Implementation Plan describes the activities to be considered over the next 10 years in order to achieve the load reductions defined in the Cedar Lake and McMahon Lake TMDL (Barr 2012).

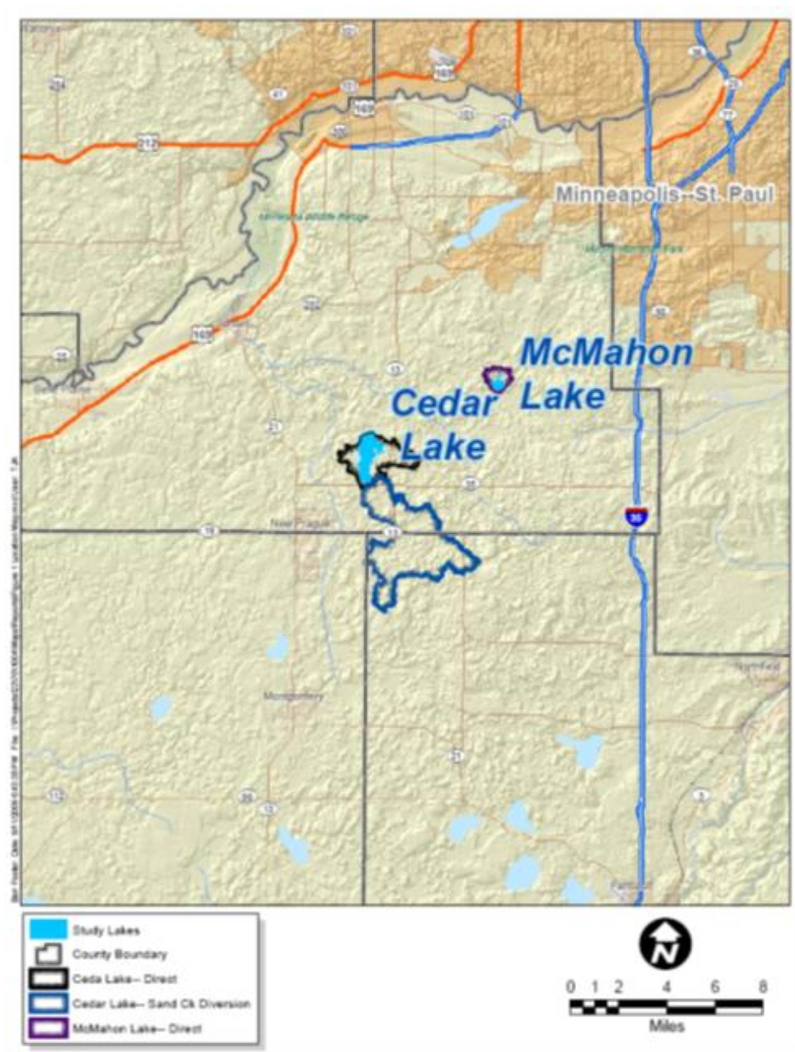

Figure 1-1. Site Location Map

Section 2.0: Description of the Water Bodies, Pollutant of Concern and Pollutant Sources

2.1 Overview of Cedar and McMahon Lakes

Cedar and McMahon Lakes are Minnesota Department of Natural Resources (DNR)-protected waters (DNR ID#70-0091 and 70-0050, respectively) located in unincorporated areas near the city of New Prague, MN. Cedar Lake is one of the largest lakes in Scott County with a surface area of 779 acres, a maximum depth of approximately 13 feet, and a mean depth of 6.9 feet. The lake is used primarily for motor boating, canoeing, fishing, picnicking, and aesthetic viewing. Cedar Lake also provides some limited wildlife habitat.

McMahon Lake is a shallow lake with a surface area of 130 acres and maximum and mean depths of 14 feet and 8.5 feet, respectively. McMahon Lake is used primarily for canoeing, fishing, picnicking, and aesthetic viewing and the lake provides wildlife habitat as well.

By MPCA (2007) definition, Cedar and McMahon Lakes are considered shallow lakes (a maximum depth of less than 15 feet and/or at least 80 percent of the lake less than 15 feet deep). The direct tributary watershed areas in comparison to each lake's surface area are relatively small (Cedar Lake = 2.1:1, McMahon Lake = 3.1:1).

Both lakes are polymictic, meaning they mix vertically multiple times throughout the year. Each water body can stratify for short periods during the growing season, followed by destratification that mixes the water column. At times, this mixing may suspend phosphorus that is released from the lake sediment (internal loading) into the water column, making more phosphorus available to algae. Another internal source of phosphorus to Cedar and McMahon Lakes is curlyleaf pondweed *(Potamogeton crispus)*. In 2007, the WMO hired Blue Water Science to conduct aquatic plant surveys on Cedar and McMahon Lakes. Results of the early season survey for Cedar Lake found that curlyleaf pondweed was the dominant aquatic plant, with coverage estimated at 771 acres, or 98% coverage of the lake. Results of the early summer survey for McMahon Lake also confirmed the presence of curlyleaf pondweed and coverage was estimated at 68 acres, with 39 acres being heavy nuisance growth. Results from the survey also found Eurasian watermilfoil *(Myriophyllum spicatum)* present in McMahon Lake at one location. Curlyleaf pondweed proliferates in the early-summer and dies off in mid-summer, releasing substantial amounts of phosphorus into the water column. In addition, common carp and black bullhead are present in Cedar Lake adding to the internal phosphorus load.

The immediate Cedar Lake watershed comprises a drainage area of 2,472 acres (including the lake surface area) and drains unincorporated areas near the city of New Prague. Development immediately around the lake is sewered. Cedar Lake receives both direct drainage from the immediate watershed and a portion of the flow from a tributary to Sand Creek which enters from a diversion weir system south of the lake. Information on each of these contributing watershed areas is presented below.

- **Direct—**This 1,862 acre drainage area (including Cedar Lake) surrounds the lake.
- **Diversion—**The approximate contributing area upstream of the diversion structure on a tributary to Sand Creek (south of the lake, Figure 1) is 7,169 acres. Only a portion of the flow from the tributary to Sand Creek is diverted to Cedar Lake however.
- **St. Patrick Wetland**—The watershed area to the east of Cedar Lake drains into the St. Patrick Wetland and then enters Cedar Lake. The approximate area of this watershed, including the wetland area, is 610 acres.

McMahon has a small, tributary watershed surrounding the lake as the main source of runoff to the lake.

Direct—This 552 acre drainage area (including McMahon Lake) surrounds the lake.

Both Cedar and McMahon Lake have winter aeration systems to prevent winterkill of game fish.

2.2 Pollutant of Concern and Pollutant Sources

The pollutant of concern in both Cedar Lake and McMahon Lake is phosphorus, measured as total phosphorus. Land use in each watershed is generally a mix of agriculture, woodland, low density urban areas, and open water or wetlands (Figure 2-1). The land uses in the tributary watersheds to each lake can be summarized as follows:

Land use in the Cedar Lake direct watershed and St. Patrick wetland includes:

- Open Water (including Cedar Lake) 33%
- Agricultural 21%
- Pasture/Range/Open/Non-Ag 14%
- Woodland 12%
- Rural Residential 12%
- Wetland 8%

Land use in the portion of the Sand Creek diversion watershed that flows into Cedar Lake includes:

- Agricultural 52%
- Pasture/Range/Open/Non-Ag 22%
- Woodland 13%
- Rural Residential 10%
- Wetland 3%

Land use in the McMahon Lake direct tributary watershed includes:

- Open Water (including McMahon Lake) 29%
- Woodland 23%
- Agricultural 21%
- Rural Residential 13%
- Wetland 9%
- Pasture/Range/Open/Non-Ag 6%

There are no significant stormwater outfalls to either lake, but Cedar Lake does receive a portion of flow from an unnamed ditch (tributary to Sand Creek) through a constructed diversion that diverts flow into the lake at the southern end. In general, only a small portion of the flow is diverted to the lake via the ditch. This occurs during the wetter periods of the year, specifically when the water level at the inlet of the diversion exceeds the elevation of the inlet to the diversion at 944.2 feet. When flow in the ditch is below this elevation it bypasses the diversion and flows to Sand Creek. Flow through the diversion is also limited by the fact that the outlet of the diversion pipe is normally below the lake level elevation 943.3 feet, while the outlet of the pipe is at 939.5 feet. This means that the diversion pipe has a tailwater condition that slows flow, and that there is only 0.9 feet of head between the inlet of the pipe and the outlet of the lake.

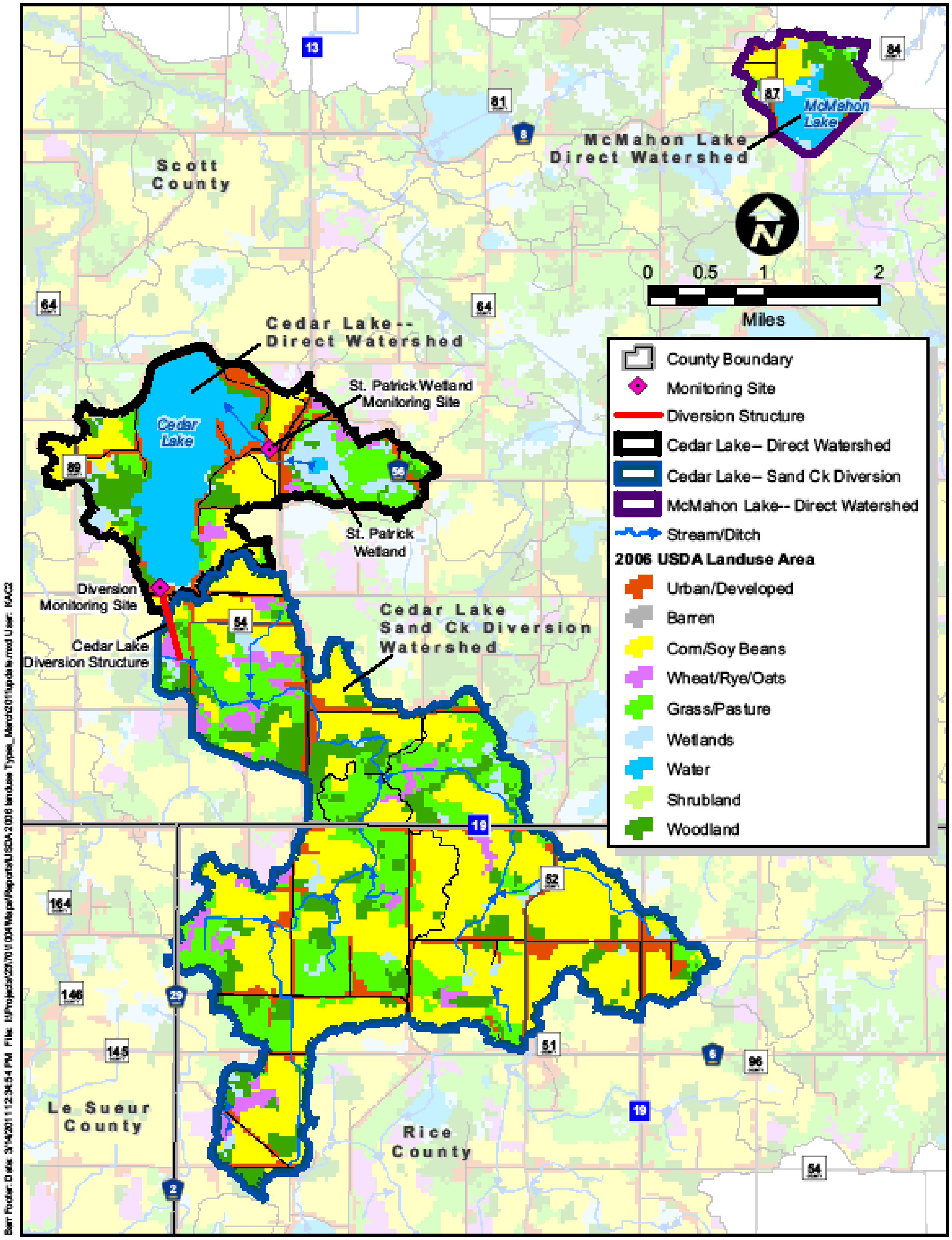

Figure 2-1. Land Use in the Cedar Lake and McMahon Lake Watersheds

Historically the diversion carried a larger fraction of the tributary flow to the lake. This was made possible by a stop log dam constructed across the tributary that raised the water level in the ditch (Figure 2-2). No easement rights were obtained for backwater flooding created by the dam, and the MDNR discontinued use of the dam in the early 1980s in response to controversy and a request by the County.

Figure 2-2. Abandoned Stop-Log Dam on Sand Creek Tributary

Large amounts of highly erodible land (HEL) are present within the Porter Creek subwatershed where McMahon Lake is located, as well as Sand Creek Tributary subwatershed which is the watershed for the diversion structure that directs flow into Cedar Lake. Twenty-nine percent (29%) of the Sand Creek Tributary subwatershed is HEL, or 2,755 acres, with 1,142 acres being cultivated (12%). The direct watershed to Cedar Lake has 424 acres of HEL out of its 1,862 acres, with 108 acres being cultivated. The direct watershed to McMahon has a total of 158 acres of HEL with 37 acres being cultivated.

The direct watershed to Cedar Lake has 48 acres of potentially restorable wetlands. The McMahon Lake direct watershed has none. The diversion watershed has over 500 acres.

Figures 2-3 and 2-4 show the relative contribution of phosphorus to Cedar Lake during the 2007 and 2008 growing seasons. Although slightly lower percentage wise during 2008, internal loading of phosphorus was still the dominant contributor of phosphorus to the lake (93%). Sediment phosphorus release, bioturbation and excretion from carp were the two highest internal loading sources contributing 3,137 and 2,351 pounds, respectively, during the year. External loading, including input from the direct watershed, St. Patrick wetland, and the diversion weir, accounted for 5.1 percent of the total phosphorus load to the lake. Precipitation contributed approximately 1.6% of the phosphorus load to the lake. Table 2-1 lists the phosphorus loads to Cedar Lake for both 2007 and 2008.

Figures 2-5 and 2-6 show the relative contributions of each phosphorus source to McMahon Lake during the 2007 and 2008 growing seasons. Internal loading was higher in 2008 (85%) of the total phosphorus load due to elevated phosphorus loading from the sediment (474 pounds). External loading accounted for 12% of the phosphorus load while precipitation was 3% of the total phosphorus load to the lake, respectively. Table 2-2 lists the phosphorus loads to McMahon Lake for both 2007 and 2008.

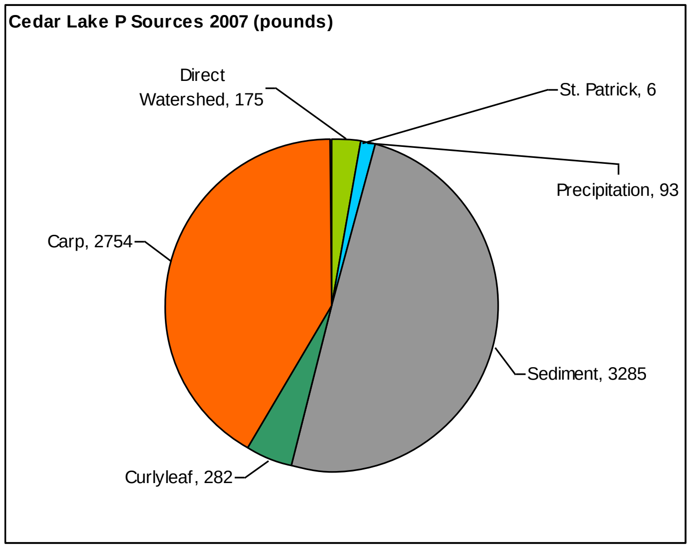

Figure 2-3. Phosphorus Sources to Cedar Lake during the 2007 Growing Season

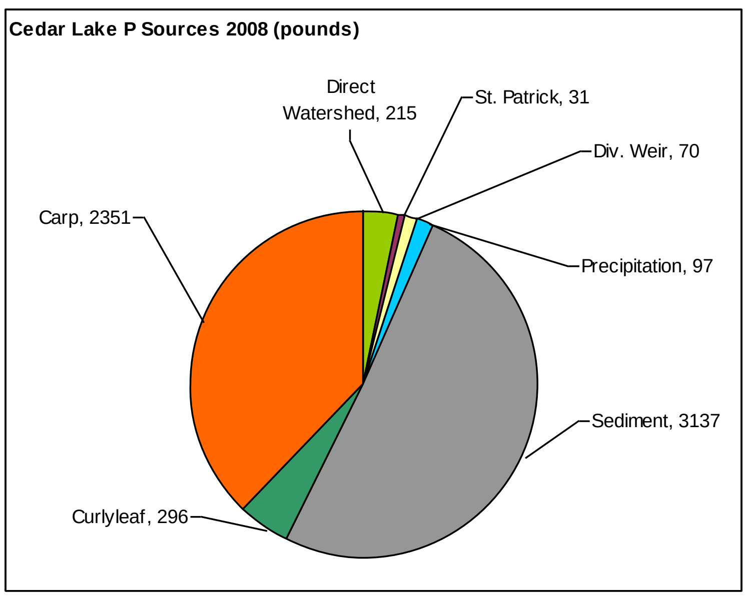

Figure 2-4. Phosphorus Sources to Cedar Lake during the 2008 Growing Season

Table 2-1. Cedar Lake Phosphorus Sources and Loads during the 2007 and 2008 Growing Season

Phosphorus Source		2007		2008	
		Pounds	Percent	Pounds	Percent
Internal	Sediment	3,285	49.8	3,137	50.6
	Carp	2,754	41.8	2,351	37.9
	Curlyleaf Pondweed	282	4.3	296	4.8
External	Diversion Weir	NA	NA	70	1.1
	St. Patrick Wetland	6	0.09	31	0.5
	Direct Watershed	175	2.7	215	3.5
	Precipitation	93	1.4	97	1.6

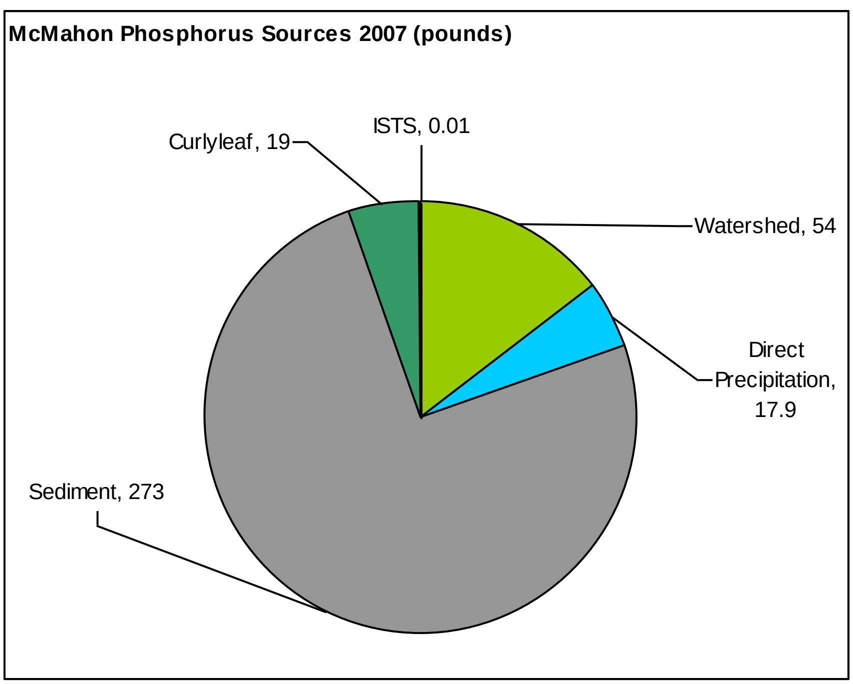

Figure 2-5. Phosphorus Sources to McMahon Lake during the 2007 Growing Season

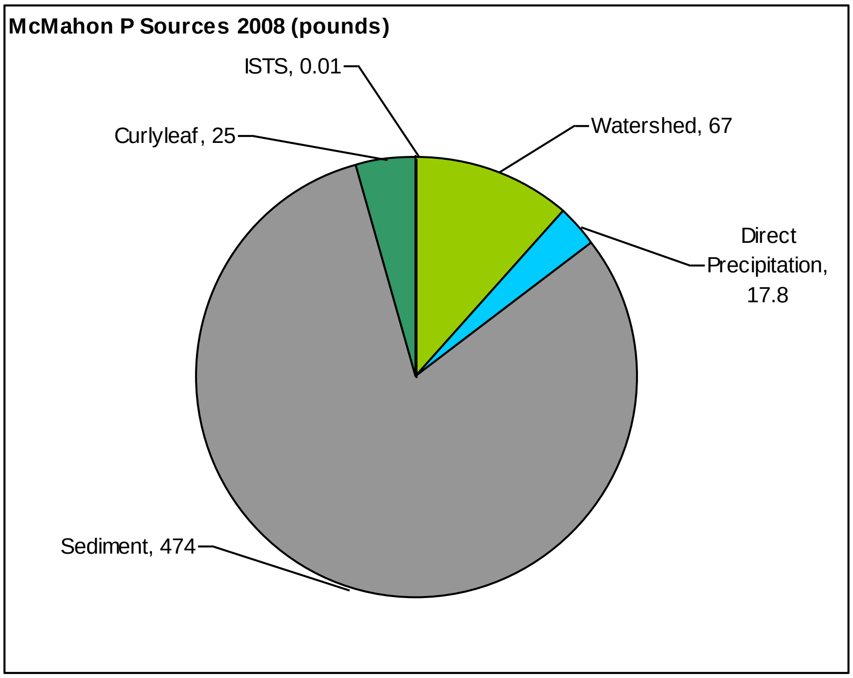

Figure 2-6. Phosphorus Sources for McMahon Lake during the 2008 Growing Season

Table 2-2. McMahon Lake Phosphorus Sources and Loads during the 2007 and 2008 Growing Season.

Phosphorus Source		2007		2008	
		Pounds	**Percent**	**Pounds**	**Percent**
Internal	Sediment	273	75	474	81
	Curlyleaf Pondweed	19	5.2	25	4.4
External	Direct Watershed	54	14.8	67	11.5
	ISTS	0.01	0.0	0.01	0.0
	Precipitation	18	4.9	18	3.1

Section 3.0: Summary of the Lake TMDL Load Allocations

The TMDL is broken down into wasteload allocations (WLAs) and load allocations (LA) for each lake. The WLA includes loads that originate in areas regulated under the State of Minnesota's National Pollutant Discharge Elimination System (NPDES) General Permit. The LA includes loads that originate in communities that are not regulated under a NPDES permit, are largely agricultural, internal loading, and atmospheric deposition.

The standards for the NCHF ecoregion will apply for these lakes. However, as stated earlier, it may be appropriate to consider applying the WCBP ecoregion (or other) standards, provided beneficial uses are met, and at that time a request for a site-specific standard would be expected to be made to the MPCA and the US Environmental Protection Agency (EPA). For future reference, the WCBP ecoregion TMDL endpoints are provided.

Cedar lake and its watershed are located in unincorporated areas where there is neither a Municipal Separate Storm Sewer System (MS4) regulated community or regulated conveyance system requiring a NPDES permit. McMahon Lake and its subwatershed are located in an MS4 community (i.e., Spring Lake Township). However, the area is unincorporated and there are no regulated conveyance systems within the McMahon Lake subwatershed. Therefore, the only wastewater allocation in this TMDL is an allowance for construction or industrial activities, assuming that 1% of the watershed area (and external load) is subject to these activities for each lake. No Concentrated Animal Feeding Operations (CAFOs) are located within either lakeshed.

Total phosphorus budgets, Waste Loads, and Load Allocations for Cedar and McMahon Lakes are presented in Tables 3-1 and 3-2, respectively.

Table 3-1. Cedar Lake Total Phosphorus Budgets and Wasteload and Load Allocations

WLA or LA	Sources	Existing TP Load (Pounds)	NCHF Ecoregion Standard, 60 ug/L			WCBP Ecoregion Standard, 90 ug/L		
			WLA/LA (Pounds/ season)	Daily WLA/LA (lbs/day) (Growing Season Pounds/138days)	% Reduction	WLA/LA (Pounds/ season)	Daily WLA/LA (lbs/day) (Growing Season Pounds/138days)	% Reduction
WLA	Construction/Industrial	NA	2.4	0.017	0	2.4	0.017	0
	Total Load Sources	NA	2.4	0.017	0	2.4	0.017	0
LA	Internal Sources (from sediment release, carp and curlyleaf pondweed)	5784	588	4.3	90	1646	11.9	72
	Non-point watershed sources	316	235	1.7	25	235	1.7	25
	Atmospheric Sources	97	97	0.7	0	97	0.7	0
	Total Load Sources	6197	919	6.7	85	1978	14.3	68
Overall Source Total		**6197**	**922**	**6.7**	**85**	**1980**	**14.3**	**68**

Table 3-2. McMahon Lake Total Phosphorus Budgets and Wasteload and Load Allocations

WLA or LA	Sources	Existing TP Load (Pounds)	NCHF Ecoregion Standard, 60 ug/L			WCBP Ecoregion Standard, 90 ug/L		
			WLA/LA (Pounds/ season)	Daily WLA/LA (lbs/day) (Growing Season Pounds/138days)	% Reduction	WLA/LA (Pounds/ season)	Daily WLA/LA (lbs/day) (Growing Season Pounds/138days)	% Reduction
WLA	Construction/Industrial	NA	0.5	0.004	0	0.7	0.005	0
	Total Load Sources	NA	0.5	0.004	0	0.7	0.005	0
LA	Internal Sources (from sediment release, carp and curlyleaf pondweed)	499	44	0.32	91	499	3.62	0
	Non-point watershed sources	67	50	0.36	25	67	0.48	0
	Atmospheric Sources	18	18	0.13	0	18	0.13	0
	Total Load Sources	584	112	0.81	81	583	4.2	0
Overall Source Total		**584**	**112**	**0.81**	**81**	**584**	**4.2**	**0**

3.1 TMDL Allocations

No reduction in atmospheric loading is targeted because this source is impossible to control on a local basis.

For Cedar Lake to meet the NCHF phosphorus threshold of 60 µg/L, growing season reductions of 81 pounds (26%) from external loading and 5,196 (90%) pounds from internal loading sources are required. A total phosphorus load reduction to Cedar Lake of 5,278 (85%) pounds during the growing season will be required to achieve to overall TMDL allocation of 922 pounds (Table 3-1).

Because the 10-year averages for water quality in McMahon Lake currently meet the MPCA standards for lakes in the WCBP Ecoregion, phosphorus reductions were not developed for that level. To meet the standards under the NCHF ecoregion, reductions of 17 pounds (26%) from external loading and 455 (91%) from internal loading sources are required (Table 3-2). The overall phosphorus load to McMahon Lake will need to be reduced by 473 pounds (81%) in order to achieve the total TMDL allocation of 112 pounds for the growing season.

There are multiple actions that are needed to reduce phosphorus concentrations in Cedar and McMahon Lakes to meet the MPCA's shallow lakes TMDL requirement of 60 µg/L. Short and long term goals are listed below and are intended to be met as the watershed and in-lake improvements are implemented in a stepwise manner. The short term goal (90 µg/L) will be met with the implementation of:

Cedar Lake:

- A 25% reduction of external loading accomplished through the Scott WMO BMP cost share program and other targeted projects
- Internal load reduction measures within the lake, designed to reduce internal phosphorus loading through sediment phosphorus binding with aluminum, curlyleaf pondweed reduction, and carp management.

To reach the long term goal of 60 µg/L, project implementation includes:

- Additional internal load reduction through ongoing carp management.

McMahon Lake:

To reach the long term goal of 60 µg/L, project implementation includes:

- A 25% reduction of external loading accomplished through the Scott WMO BMP cost share program

- Internal load reduction measures within the lake, designed to reduce internal phosphorus loading through sediment phosphorus binding with aluminum and curlyleaf pondweed reduction.

Section 4.0 Identification and Assessment of Options

4.1 Context for Achieving Load Reductions

Both lakes are situated within the NCHF ecoregion but are 10 to 15 miles from the boundary of the WCBP ecoregion. Because of this, the TMDL implementation strategies for each lake were developed with dual endpoints serving as short-term (WCBP) and long-term (NCHF) objectives. The TMDL implementation strategies focus on reducing both external (watershed) sources of phosphorus and internal, in-lake sources of phosphorus as presented in the previous section.

Attaining either the WCBP or the NCHF standard for Cedar Lake will be challenging, as will attaining the NCHF standard in McMahon Lake without increasing problems from known exotic plants that currently infest McMahon Lake. The lakes are shallow and most of the existing load is from internal sources. Control of these internal sources in shallow lakes is challenging, and the science is still evolving for some practices. There is better assurance of the watershed load reductions. Cedar Lake is also physically altered with its depth increased five feet in the 1950s when a new outlet was constructed, and its watershed was also altered in the 1930s with the construction of the diversion. Because of these challenges, it is recognized that an adaptive approach will be needed. Adaptive management is an iterative approach for implementation, evaluation, and course correction. The phosphorus load reduction projects will be implemented in a sequential manner with monitoring and assessment providing a feedback loop for evaluating course corrections. This is a 10 year plan, however, restoration could take longer, or actions could intentionally be spread out over a longer period of time.

A few projects benefiting the Lakes have already been completed prior to this report, and where it makes sense, the Scott WMO and its partners have incorporated existing local programs into the TMDL Implementation Plan. The Plan also recognizes that external watershed loads were significantly reduced in the early 1980's when the stop-log dam on Sand Creek tributary was abandoned since this action reduced the amount of flow diverted to the lake.

Many organizations, individuals and agencies were consulted in the development of this plan to identify and select management options and determine their sequencing for implementation. These include the Cedar Lake Improvement District, the New Market Sportsmans Club, the Minnesota Pollution Control Agency (MPCA), the Minnesota Department of Natural Resources, the Scott Watershed Planning Commission, the Scott County and Scott WMO Board, Township Supervisors, and interested citizens. In addition, two public meetings were held over the course of the project. There are some differences in perspective, but all are committed to improving the water quality of the lakes and are willing to work together. It is also recognized that some management approaches will require permits and concurrence with state agencies. These include aquatic plant management/treatment where the MDNR administers permits, and in-lake alum treatments where the MPCA does the permitting. It is expected that these agencies will consider permit approval in context of their preferences for sequencing the management, the overall comprehensiveness of the Plan, and demonstrated progress of the various Plan elements. Additional detail on the conversations and preferences of the various groups is provided below under the discussion of sequencing.

With respect to financing implementation of this Plan, the Scott WMO and the Cedar Lake Improvement District are set up as local taxing districts and have the capability to levy for some improvements. The Plan takes advantage of many existing Scott WMO programs as discussed for various management practices below. However, the tax capacities of the two organizations are not very large. There are less than 50 property owners in the McMahon Lake watershed, and less than 1,000 in the Cedar Lake watershed. Thus, the ability to implement some of the practices, or the rate of implementation, will be dependent on additional State and Federal assistance. Other entities are expected to fulfill their existing responsibilities in water management to help meet the goals of this TMDL. Particularly, because these are “waters of the state", the Scott WMO, the County and other local units of government expect state and federal assistance.

4.2 Assessment of External (Watershed) Source Reduction Options

Review of watershed characteristics in Cedar and McMahon Lakes shows that the greatest potential for external phosphorus reductions comes from improved shoreland practices, improved conservation on Highly Erodible Lands (HEL), additional filter strips, conversion of agricultural land to rural residential land through the development process, and from the development of Cedar Lake Farms Regional Park. Restoration of wetlands for reducing phosphorus presents some opportunity. Improved management of septic systems, is not a significant opportunity, nor is stream channel stabilization, floodplain reconnection, or urban stormwater management. Each of these opportunities is discussed briefly below.

For Cedar Lake it is recognized that improvements in the direct watershed will have a greater benefit than from those made in the diversion watershed. Thus, investment in the direct watershed has a higher priority than the diversion watershed. As shown in the TMDL report, the amount from the diversion watershed varies significantly from year to year. In 2007, flow into the lake from the diversion watershed was zero as was phosphorus loading. There was flow and phosphorus loading from the diversion to the lake in 2008, but the loading was only about 1/3 of the phosphorus load from the direct watershed. The exception is practices that help reduce dissolved phosphorus. While the overall yields of total phosphorus are relatively low in the diversion (ST2) subwatershed (see Figures 4-3 and 4-4), a majority of the Total Phosphorus is in dissolved forms (i.e., 70% in 2007 and 62% in 2008). This is a concern since the dissolved fraction is more available for uptake by algae.

4.2.1 Shoreland Improvements. A shoreland conditions inventory was completed for each lake as part of the TMDL study. These inventories found that much of the shoreland of Cedar Lake has been altered. The shoreland of McMahon Lake remains largely unaltered, except one area where significant erosion was identified. Thus, improved shoreland management presents an opportunity for reducing phosphorus from the direct watersheds of both lakes. The inventories will be used to help target the Scott WMO cost share program (described below under subsection 5.1.2 Future Watershed Actions) to work with land owners where these types of improvements make the most sense. Targets will be contacted as part of the Scott WMO and Scott SWCD's annual planning for targeting BMPs. The McMahon Lake shoreline erosion areas have already been targeted. One has been approved and completed. The phosphorus reduction estimate from the completed project is 15 lbs/year.

It is also anticipated that the Scott WMO will promote better shoreland management through education efforts. The Scott WMO has held workshops in the past for residents interested in shoreland restoration. As a result, several small restoration projects have been approved in the past four years around Cedar Lake. One stabilization project has been completed with an estimated phosphorus reduction of 8 lbs/year.

4.2.2 Conservation on HEL. There are over 100 acres of cultivated HEL in the Cedar Lake direct watershed and over half of the cultivated acreage in the McMahon watershed is HEL. In addition, 12% of the Sand Creek Tributary subwatershed that is linked to Cedar Lake by the diversion structure is cultivated HEL. Targeting these areas for the production of an alternative native grass crop presents a significant opportunity for phosphorus reduction.

There are three reasons why this is anticipated to be an accepted practice by land owners. First, much of the Scott County portion of the direct and indirect watersheds is guided for future development as rural residential with lot sizes ranging from 2.5 to 10 acres. These property owners typically are not farming the land themselves, and are open to other options for stabilizing the land. Second, there may be an emerging market for an alternative grass crop with the construction of the Koda Electric facility in Scott County that runs by burning biomass. Third, some incentives are available to help property owners establish native grass plantings. The Scott WMO added native grasses to its cost share docket, and has been successful at getting Minnesota DNR

Working Lands Initiative funds and Clean Water Funds to match its efforts for establishing native grasses on private lands. The NRCS Wildlife Habitat Improvement Program (WHIP) also offers a modest cost share. Incentive payments range from $150 to $250/acre per year, with cost share ranging from 50% to 100%. Furthermore, one 20 acre planting has recently been approved on the north shore of McMahon Lake. Currently the Scott WMO only has sufficient incentive funding for another 25 acres, of which the Cedar and McMahon watersheds are only a small portion of the area targeted for this incentive.

In general conversion of cropland to native grasses is estimated to reduce phosphorus export by 0.345 lbs/year using the same land use phosphorus export coefficients used in the TMDL study.

- TP reduction for cropland converted to grass = ((1 acres cropland) x 0.54 kg/ha/year)) - ((1 acres grass)x(0.151 kg/ha/year)) = 0.345 lbs/year

For the 20 acres just approved next to McMahon Lake this would total 6.9 lbs/year.

4.2.3 Filter Strips. Both the Scott WMO and the Rice SWCD have identified areas where cropping occurs within 50 feet of the Sand Creek tributary in the diversion watershed. In Scott County these areas occur along short reaches in Cedar Lake Township sections 29, 30 and 32. In Rice County they occur in Wheatland Township Section 4. Both organizations anticipate using this information for targeted land owner contacts to promote the federal Conservation Reserve Program (CRP) and other local cost share programs for filter strips. The Rice SWCD has already started making calls. Scott WMO anticipates prioritizing the Sand Creek Tributary subwatershed for targeted land owner contacts in 2012.

In general, CRP or other local filter strips programs are an accepted practice in the area provided the incentive amount is competitive with cropland rental rates. Harvestable filter strips are also more popular than non-harvestable. Crop rental rates in the area are approaching $200 to $250/acre. Unfortunately land in CRP generally cannot be harvested without a penalty, and payment rates for CRP are closer to

$150/acre depending on soil type. Thus, the Scott WMO provides an additional supplemental payment for CRP, and has its own program for promoting harvestable filter strips. Currently the Scott WMO covers the cost of the payments through its cost share program which is largely raised by levy over the WMO's special taxing district. Some additional funds are available over the next few years for harvestable filter strips through a USEPA Section 319 Implementation grant awarded to the WMO in 2009. Rice County areas of the diversion watershed are eligible for this grant. The WMO anticipates continued pursuit of grant funding to enable greater implementation of this practice, as well as partnering with the Rice SWCD to pursue grants.

4.2.4 Conversion of Agricultural Land to Rural Residential. The entire McMahon Lake watershed and the Scott County portions of the Cedar direct and diversion watersheds are guided for future development as rural residential. Moreover, rural residential is an end land use zoning in this area, and not an interim use to be developed at a higher density at some later date. Land use in the Rice County portions of the diversion watershed are not expected to change much in the next 20 years.

It is expected that phosphorus export will decrease as land use changes from row crop to rural residential in this area. This is due to a combination of the establishment of large lots guided as 2.5 acres per lot, and the development standards of Scott County and the Scott WMO. In general, these standards exceed the MPCA standards for the NPDES General Construction permit. Scott County standards and criteria are included in County zoning ordinance Chapter 6, while Scott WMO standards are included in the new Comprehensive Water Resources Management Plan. Basic requirements of these standards are:

1. Construction erosion control per the MPCA requirements in the NPDES General Construction permit for disturbed areas greater than 1 acre, with a simple erosion and sediment control plan required for disturbances less than 1 acre.
2. Control of peak runoff rates to presettlement conditions using the curve numbers in Table 4-1.

3. Runoff volume control consisting of retention or infiltration of ½ inch of runoff from all newly created impervious surfaces.
4. Wet Ponds in accordance with MPCA standards in the NPDES General Construction permit.
5. Wetland and watercourse buffers ranging from 25 feet to 65 feet depending on wetland quality.

Table 4-1. Pre-Settlement Curve Numbers Specified by Scott County

Hydrologic Soil Group	Runoff Curve Number
A	**30**
B	**55**
C	**71**
D	**77**

Groundwater system modeling by BARR (2009) for this area with these standards in combination with rural residential development showed that on average, groundwater recharge will increase by 1.6 inches. This increase in recharge is primarily a function of reduced runoff and a greater potential for water to infiltrate beyond the root zone. Recharge also increases as a result of septic systems.

The Scott County 2030 Comprehensive Plan update also allows for the use of a Planned Urban Development (PUD) tract that includes Public Value Credits (PVC). The PVC system identifies potential items that may be of benefit to the county as the property is developed. If the developer is willing to provide certain items under the PVC system, they can be awarded additional density as part of their development. This means that the overall project density may increase to a level more dense than the "base" 2.5 units per acre. Actions that receive credit under the PVC program include dedication of right of way for county roads above and beyond the normal right of way required, usage of community managed septic systems, use of a common well, dedication of park land that is desired by the township or county, construction of trails or connection of trails, preservation of important natural communities that are not otherwise protected, regional stormwater ponding facilities, livable community features like Low Impact Development (LID), and wetland restoration.

It should be noted that water quality changes resulting from this land use conversion are expected to be slow. The area surrounding McMahon Lake is likely to build out faster than the Cedar Lake watershed. The area surrounding McMahon Lake is in Spring Lake Township and is further north. Northern areas are developing faster, and Spring Lake Township is rapidly embracing the requirements necessary to rezone to the 2.5 acre lot size.

4.2.5 Development of Cedar Lake Farm Regional Park. Scott County recently acquired Cedar Lakes Farm Regional Park on the southwest side of Cedar Lake. Regional Parks operated by the County have a natural resource based focus. The Park totals about 300 acres of which 119 acres are in the Cedar Lake direct watershed. Of this 23 acres are cropland, 74 acres are Maple Basswood forest, and 22 acres are grass/forest picnic area.

There are three areas where Park development could lead to water quality improvements. First, it is expected that most of the cropland and about one-half of the grass/picnic area will be restored to native plant communities. Second, there is a need for shoreland stabilization and restoration on the property. Third, water quality practices could be included on park property. Each of these opportunities is discussed below.

Shoreline Improvement. Total, there is about 4,000 feet of shoreline, at least half of which could be improved with native plantings and some of which needs stabilization. At $100 per linear foot, 2,000 feet of improvement is about $200,000. Funding is in place to work with Great River Greening on this shoreline in 2012 and 2013 through a combination of LCCMR and Scott WMO funds. There is also an area of shoreline erosion at the north end of the park on the west side of the lake. A shoreline stabilization project is planned for this area. Funding is in place from the Scott WMO and the Clean Water

Fund and completion in 2012. The estimated phosphorus load from this eroding area is 11 lbs/year.

Native Vegetation Restoration. The cost of restoring cropland areas to native plant communities will vary depending on the native community desired. The two communities most likely targeted include maple basswood forest and native grasses. According to Great River Greening (2009) the cost for converting row crop land to upland hardwood forest is $710/acre, while the cost for converting cropland to native grasses is $1,000/acre. Assuming that 100% of the cropland acreage in the park is converted to an equal amount of grassland and forest, the load reduction would be about 8.2 lbs/year using the same land use phosphorus export coefficients used in the TMDL study.

- TP reduction for 11.5 acres of cropland converted to forest = ((11.5 acres cropland) x 0.54 kg/ha/year)) - ((11.5 acres forest) x (0.13 kg/ha/year)) = 4.2 lbs/year
- TP reduction for 11.5 acres of cropland converted to grass = ((11.5 acres cropland) x 0.54 kg/ha/year)) – ((11.5 acres of grassland) x (0.151 kg/ha/year)) = 4.0 lbs/year

Cost for converting the 23 acres would range from $16,330 to $23,000 depending on choice of native grass or forest.

Water Quality Practice Implementation. The County and the Scott WMO are investigating the feasibility and benefits of constructing water quality practices on park property that would not only treat park land, but also runoff from surrounding lands. Two feasibility studies are complete. One assessed the feasibility of constructing a treatment wetland at the outlet of the diversion watershed on the south end of the lake. The other assessed the potential to install water quality practices in a small agriculturally dominated watershed on the west side of the lake.

The study focusing on the treatment wetland at the diversion outlet did not find a feasible alternative (AES, 2010). Unfortunately the area available for a treatment wetland is small and little phosphorus removal benefit could be documented. The Scott WMO will continue to look at this area for a rough fish migration barrier, or to find a means to decrease pollutant loads during high flow while maintaining the ability of the diversion to help maintain lake levels during dry periods.

The study on the small West Cedar Lake Subwatershed assessed the feasibility of installing water quality practices on park property (AES, 2011). This subwatershed has a drainage area of 224 acres, only some of which is park property (Figure 4-1). The park property is located on the downstream end of the subwatershed such that practices could treat runoff from offsite as well as the park. The subwatershed currently is largely in row crop with drainage provided by a private ditch and tiles. Future park plans for this area include a dog park and native vegetation. Two alternatives were assessed. The preferred alternative shown in Figure 4-1 consists of four biocells and two filter strips. The overall phosphorus removal efficiency of the alternative is estimated at about 31%, with average annual removal estimated as 35 lb/yr. The estimated construction cost with three years of maintenance is roughly $81,000.

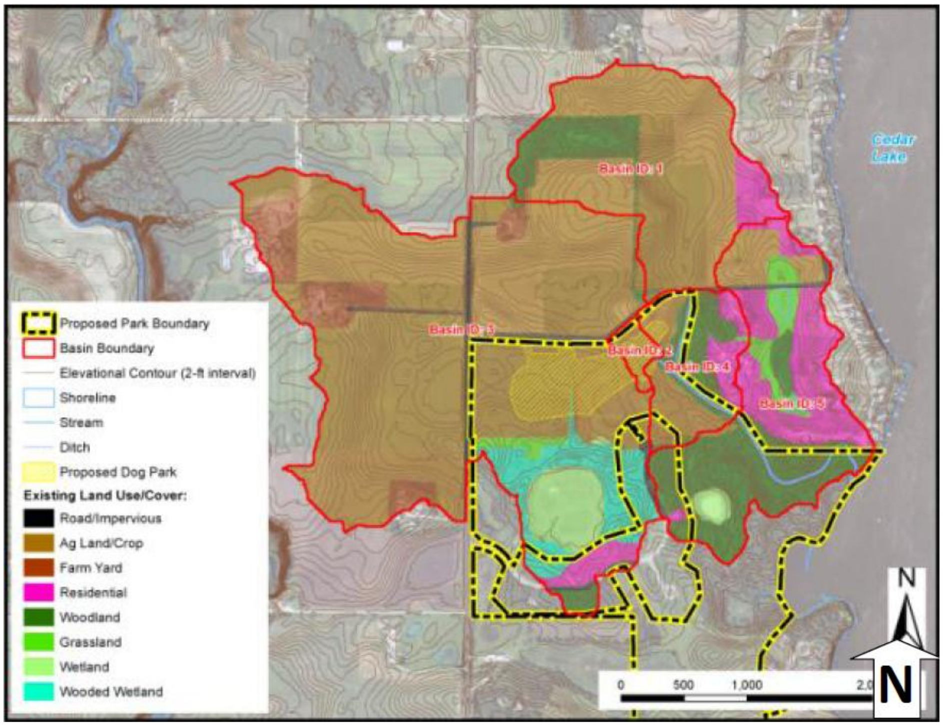

Figure 4-1. West Cedar Lake Subwatershed

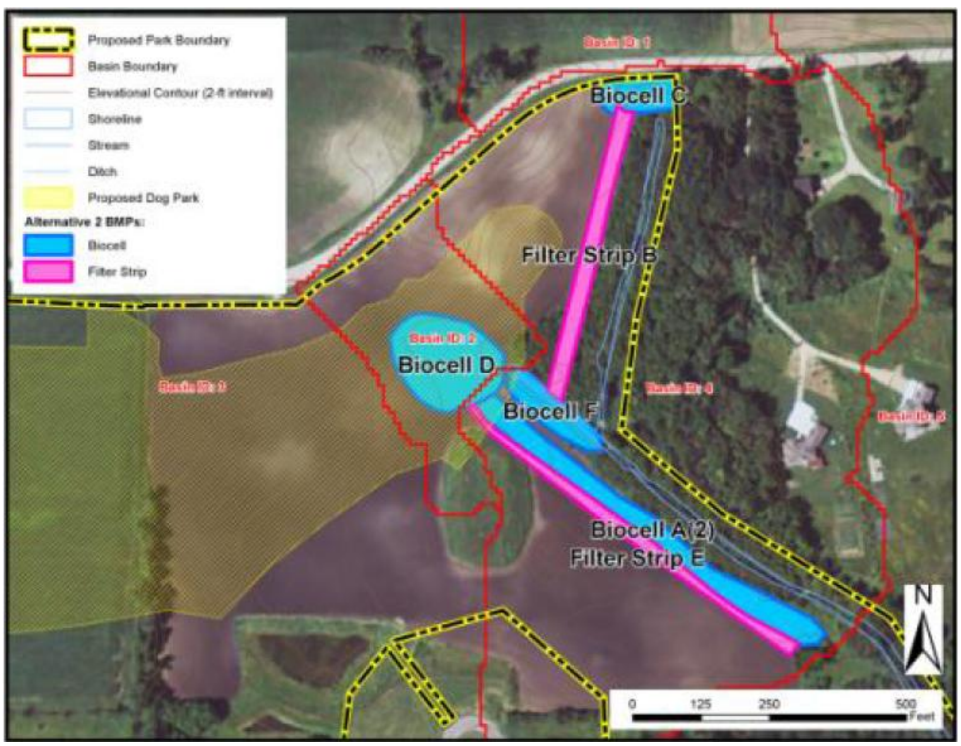

Figure 4-2. Preferred Alternative for the West Cedar Lake Subwatershed

4.2.6 Wetland Restoration. Wetland restoration does not appear to be a strong option as a management strategy in the direct watersheds for either Lake. In the McMahon Lake watershed, no restorable wetlands have been identified. In the direct Cedar Lake watershed, there are only 48 acres of restorable wetland, and only one is greater than 10 acres, meaning that pursuing these could take a lot of administrative effort.

There are over 500 acres of restorable wetlands in the diversion watershed to Cedar Lake. Most of this acreage is associated with one large wetland complex. However, much of the area has already been subdivided into 5 to 10 acre lots such that more than 20 property owners would need to give approval for a restoration to take place. In addition, portions of the ditch draining the wetland are part of the County Ditch system (County Ditch 8). Additional detail on the feasibility of restoring this wetland is provided in Volume 2 Sand Creek Implementation report under Targeted Project #3A - Cedar Lake 32 Ditch Modification/Floodplain Reconnection. The project was not advanced due to low feasibility.

Other wetland restoration opportunities in the diversion watershed are currently being pursued under a special Wetland Reserve Enhancement Program (WREP) funding initiative provided by the NRCS to the Scott SWCD for the Sand Creek watershed. To date several applications have been submitted, however, only one has been accepted by NRCS. This application was for a 17.1 acre restoration with a 9.4 acre buffer in the Rice County portion of the diversion watershed. It is expected that closing on the easements will be completed late 2012 with construction of the restoration and establishment of the buffer in 2013. It is also anticipated that a milk-house runoff problem will also be corrected with the project using the NRCS Environment Quality Incentive Program (EQIP) for funding assistance.

Per Richardson and Qian (1999) the average phosphorus assimilative capacity of north American wetlands is 1g/m^2/year. At this rate every ten acres of wetland restoration has the potential to provide approximately 90lbs of phosphorus assimilation annually.

- 1g/m^2/year TP x 4046 m^2/acre x 10 acre x 1 Kg/1,000g X 2.2 lbs/Kg = 8.9 lbs/year

Thus, the application currently being processed has the potential to assimilate about 150 lbs/ yr phosphorus. The 9.4 acres of buffer could add another 3.2 lbs/yr reduction. However, since this is in the diversion watershed the reduction fraction diverted to the lake is unknown and is likely much lower.

4.2.7 Septic System Improvements. Septic system improvements will not provide significant phosphorus reductions for either lake. The shoreland around Cedar Lake was recently sewered, while in the McMahon Lake watershed there are only a handful of residences and no known problem systems.

4.2.8 Stream Channel Stabilization. There are no defined channels in the McMahon or Cedar Lake direct watersheds. There is a channel in the Cedar Lake diversion subwatershed. The geomorphic study completed for the Sand Creek Impaired Waters Study found that this channel was degrading or incising slightly. However, the study also found that sediment yield in this tributary was relatively low even with the slight degradation compared to other Sand Creek subwatersheds. Total phosphorus yields in this subwatershed were also low compared to other Sand Creek subwatersheds (see the ST2 subwatershed in Figures 4-3 and 4-4, for 2007 and 2008 yields, respectively).

Most of the active degradation is located upstream of the large wetland complex near the Hwy 19 crossing at the County line. Just north of the Highway there is a knick point in the channel that is cutting back toward the highway. However, once it gets to the highway the road crossing will serve as a grade control. The preliminary cost estimate for stabilizing the channel in this area was $244,000. This was considered too expensive given the potential benefit. Additional detail on the feasibility of restoring this potential project is provided in the Volume 2 Sand Creek

Implementation report under Targeted Project #3D - Cedar Lake 33 Channel Stabilization (Scott WMO, 2010).

4.2.9 Floodplain Reconnection/Natural Channel Restoration. There are several potential projects along the channel in the Cedar Lake diversion watershed where the incised channel could either be restored or reconnected with the floodplain. Preliminary cost estimates for these ranged from $155,000 to $267,000. These costs were considered too expensive given the potential benefits. As stated previously this tributary had relatively low sediment and phosphorus yields. In addition, the property owner did not seem particularly interested in these projects. Additional detail on the feasibility of these potential projects is provided in the Volume 2 Sand Creek Implementation report under Targeted Project #3B – Cedar Lake 33 Floodplain Reconnection, and Targeted Project #3C - Cedar Lake 33 Natural Channel Restoration (Scott WMO, 2010).

4.2.10 Urban Stormwater. Load reductions for construction storm water activities are not specifically targeted in this TMDL. It should be noted that construction storm water activities are considered in compliance with provisions of this TMDL if they obtain a Construction General Permit under the NPDES program and properly select, install and maintain all BMPs required under the permit. Includes any applicable additional BMPs required in the Construction General Permit for discharges to impaired waters, or meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit.

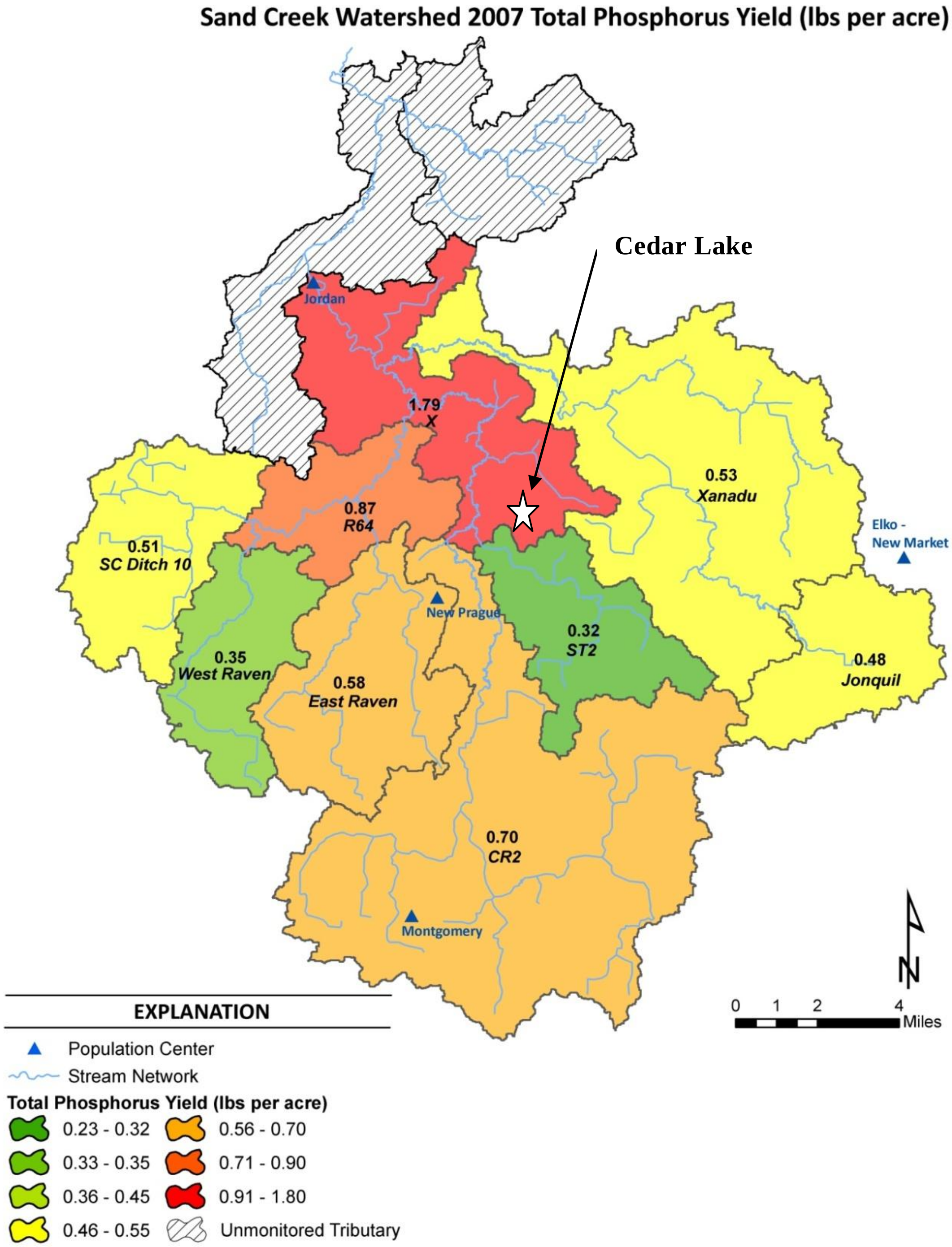

Figure 4-3. Sand Creek Total Phosphorus Yields, 2007 (Note most of the ST2 Subwatershed Can Flow Through the Diversion Structure to Cedar Lake)

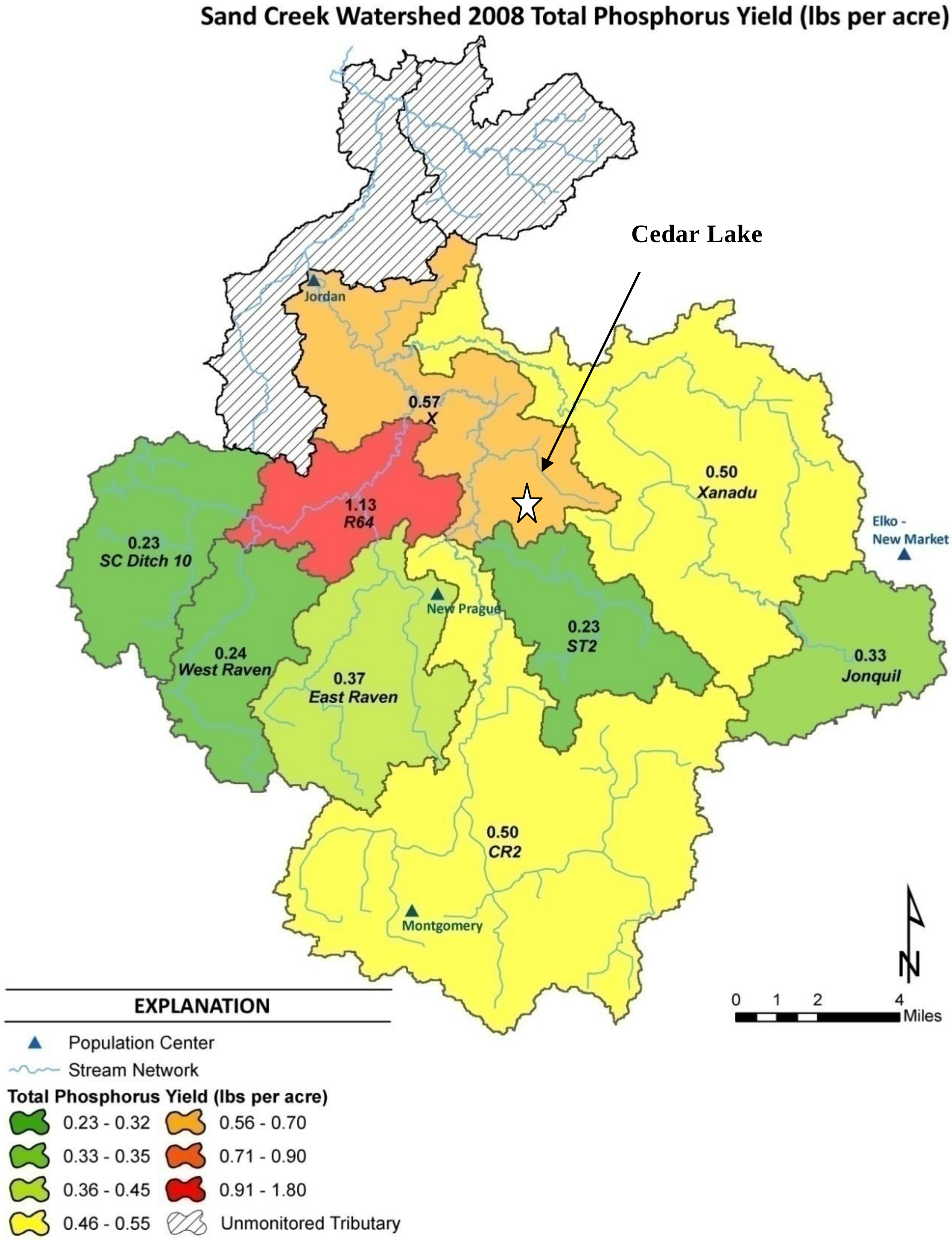

Figure 4-4. Sand Creek Total Phosphorus Yields, 2007 (Note most of the ST2Subwatershed Can Flow Through the Diversion Structure to Cedar Lake)

4.3 Assessment of Internal Source Load Reduction Options

A number of different options were considered for reducing internal phosphorus loads in each lake. These are discussed briefly below.

4.3.1 Aquatic Plant Management. Cedar and McMahon Lakes are both infested with curlyleaf pondweed. McMahon Lake also has Eurasian watermilfoil. Curlyleaf pondweed as discussed in the TMDL report, contributes to phosphorus loading. Eurasian watermilfoil may actually help improve water clarity. However, both plants need to be carefully managed so that they do not become either a continuing, or an expanding problem. In particular, there is concern that the Eurasian watermilfoil in McMahon Lake could expand its coverage with efforts to control curlyleaf pondweed and improve water clarity. Both lakes are shallow and improved clarity will allow for plant growth to deeper depths. For the ecological health of these lakes it would be better if this growth were in native plants. Native plants, with some possible exceptions, should have a smaller impact on recreation.

Initially, Aquatic Plant Management Plans will be needed for both Cedar and McMahon Lakes to satisfy permit requirements for macrophyte management on a whole lake basis. McMahon Lake is a Natural Environment Lake where the use of herbicides is prohibited. However, MDNR has indicated that it will consider requests that are part of a larger overall comprehensive strategy for improving the lake. MDNR has also indicated a willingness to lead development of such a plan for Cedar Lake. Without MDNR's help, such plans are expected to cost between $6,000 and $10,000 per lake. The Scott WMO will provide a 50% match if local organizations complete Aquatic Plant Management Plans.

The plans will need to consider treatment methods and timing, the areas to be treated, costs, and the likelihood of on-going management. One particular concern for Cedar Lake that will need to be addressed is whether or not native plants will come back. The aquatic plant surveys completed, found almost complete dominance of the aquatic plant community by curlyleaf pondweed. The only other native submerged species found was sago pondweed, and that was only at one location. Aquatic plants are needed for a healthy lake. For Cedar Lake in particular, since it is shallow and has a long wind fetch, the absence of any submerged aquatic plant growth could make conditions worse because of wind resuspension of bottom sediment. It is therefore unlikely that the MDNR will permit a whole lake treatment. A more likely approach includes the initial treatment of pilot areas combined with monitoring to assess a native plant response. Then, if successful, efforts could be phased or rotated around the lake to slowly change the plant community to native plants. This will likely need to be a long term effort to control the curlyleaf pondweed as it is unlikely that it would ever be eliminated.

The Cedar Lake Improvement District received a bid for whole lake treatment in 2009 at $175,000. Pilot testing will be a fraction of this cost depending on the size of the area treated. Assuming a pilot test and then on-going rotating treatment of about ¼ of the lake per year, this would amount to $40,000 to $50,000 per year. It is expected that this may decrease over time as the dominance of curlyleaf pondweed is reduced. The Scott WMO will match up to $15,000 per year for treatment. It's likely that treatment will need to be continued for 3 to 5 years for each area treated, with on-going spot treatment after that.

For McMahon Lake the curlyleaf pondweed coverage is much smaller and the lake is smaller. A total of 68 acres of curlyleaf pondweed was found in 2007 of which 39 acres were at a nuisance density. The amount of Eurasian watermilfoil is unknown since the 2007 survey found it at only one location. Thus, it is likely that another survey will be needed prior to the completion of an Aquatic Plant Management Plan. Prorating the Cedar Lake bid costs to the acreage on McMahon Lake gives a cost range of $17,000 to $20,000 for treating all 68 acres. It's likely that treatment will need to be continued for 3 to 5 years, with on-going spot treatment after that. There would also be an additional cost for treating the Eurasian watermilfoil since the treatment timing is different. Since McMahon is a Natural Environment Lake the cost share percentage and maximum by the Scott WMO will be determined as a specific case.

4.3.2 Lake Drawdown. Drawing down the lakes over a winter was considered as a method for controlling both carp/rough fish, and curlyleaf pondweed. However, it is not feasible for McMahon Lake since the lake watershed internally drains and there is no defined outlet.

For Cedar Lake a drawdown is possible with either a siphon or a pump placed at the outlet structure. However, the solution would not be permanent for rough fish unless the Sand Creek tributary diversion structure was made inoperable. Review of past MDNR fishery survey reports found notations that indicated that before the winter aerator was placed on the lake there was a fish kill about every 7 years, but the carp rapidly re-colonized the lake through the diversion structure. Furthermore Cedar Lake is recognized as a very good sport fishery and public support is not there for killing off and restarting the fishery. The same is true for a rotenone treatment. The fishery would also have to be restocked. There is also some concern by lakeshore residents that the lake might not fill back up again for years given the small watershed size and limited inflow from external sources (i.e. St. Patrick Wetland and the diversion weir). Costs for a drawdown include the costs for a siphon or pump at the outlet, funds for restocking, and funds for blocking the diversion structure. These costs are estimated to be in the range of $75,000 to $100,000.

4.3.3 Dredging. Dredging was of interest to Cedar Lake lakeshore residents since dredging could be a fix to many of the lake issues making the lake areas too deep for submerged aquatic plants while removing nutrient rich sediment. The project team therefore agreed to assess this practice. Dredging can be very expensive and the cost depends on the distance to the dredge disposal site. Therefore a range of cost was used with low cost at $12/cubic yard (cy), and a high cost of $18/cy. In addition a couple of scenarios were addressed: 1) making 50% of the lake non-littoral (i.e., deeper than 15 feet), and 2) changing the lake to polymictic mixing status (based on Osgood Index value of 6). Results of the analysis are presented in Table 4-2. Because of the high cost, dredging was not pursued further.

Table 4-2. Cedar Lake Dredging Cost Estimates

Option	Dredge Volume, cy	Cost at $12/cy	Cost at $18/cy
50% of Lake > 15 feet	6,100,000	$73,200,000	$109,800,000
Change mixing status	35,200,000	$424,400,000	$633,600,000

4.3.4 Fish Management and Rough Fish Control. Carp control is an emerging science, and thus, internal load reduction through management of the fishery in Cedar Lake may be difficult to achieve. In addition, black bullhead, another rough fish that causes sediment resuspension issues, is known to exist in Cedar Lake. Instigating a fish kill by either a lake drawdown or with rotenone is not an option for Cedar Lake at this time due to a lack of public acceptance. Cedar Lake is recognized as a very good sport fishery and public support is not there for killing off and restarting the fishery.

Two other options are to wait for better science to develop, or to promote commercial fishing. The University of Minnesota is currently studying ways to improve carp control. Other watershed organizations are also doing carp/rough fish studies. It makes some sense to wait for results of these studies instead of incurring large expenses at this time. Aggressive commercial harvesting has potential for reducing the biomass of carp, but not for eradicating. The efficiency of harvesting could also be improved with a study identifying where the carp school is in the winter. However, it would also likely need to be promoted as an on-going maintenance activity.

Costs of a study are estimated at about $50,000. This study would provide information to the public on the status of the fishery, and in particular carp, in Cedar Lake. The results will be used to evaluate the appropriate methods for carp reduction and to determine the expected water quality and fisheries management benefits.

To get a commercial harvester to focus on Cedar Lake it will likely require a subsidy. This is due to the current low demand for rough fish as a food. Past experience with a similar efforts on Spring Lake in Scott County suggests that the subsidy would need to include a mobilization charge of around $5,000 plus a per pound subsidy of around $0.10 to $0.20. Assuming an annual harvest of around 25,000 to 50,000 pounds this would be an annual cost of $7,500 to $15,000 including the mobilization.

4.3.5 Inactivation of Sediment Phosphorus. Based on current sediment phosphorus data for Cedar and McMahon Lake gained in the Internal Phosphorus Loading Study (Barr 2007), sediment phosphorus levels that contribute to internal loading can be reduced through sediment inactivation (e.g. alum application). Reducing the amount of phosphorus in the sediment that is available for release will reduce internal phosphorus loading in each lake. However, sediment nutrient inactivation for reducing sediment phosphorus release in shallow lakes is uncertain and an emerging science. This is mainly due to under dosing of phosphorus binding metals (e.g. alum) but also the relatively large impact littoral interactions between sediment and water can have (e.g. bioturbation and diurnal changes). This means that the lakes may require multiple or periodic treatments. Estimated alum dosage and costs for Cedar Lake are summarized in Table 4-3. Prorating the costs from Table 4-3 gives a cost range of $87,600 to $175,250 for treating McMahon Lake.

Table 4-3. Cedar Lake Sediment (Alum Treatment) Dosage and Cost Estimates[1]

Parameter	Units	Total
Alum	Gallons	724,759
Alum	Gal/acre	930
Mobilization		$5,000
Number of Treatments		2
Cost per Treatment[2]		$525,084
Cost of Split Treatment		$1,050,167

[1]From BARR (2007) included as Appendix B Cedar and McMahon Lakes TMDL Report

[2]Includes engineering, permitting and treatment monitoring

4.4 Sequencing Internal Source Load Reduction Actions

Over the course of developing this Implementation Plan there has been much discussion regarding the proper sequencing of the internal source load reduction actions. This debate revolves around whether:

- It is better to first pursue sediment phosphorus inactivation, thereby reducing algae and improving water clarity so that curlyleaf pondweed turions throughout the lakes sprout, making subsequent treatment of the curlyleaf more effective; or

- Should internal management start with macrophyte management, to demonstrate whether or not effective curlyleaf pondweed control can be achieved before completing the capital intensive sediment treatments?

There is some concern that clarity may need to be improved before native plants can compete and thrive. These sequences were grouped into lake management options in Tables 4-4 and 4-5 with pros and cons discussed.

Table 4-4. Cedar Lake phosphorus reduction management options and sequencing

Cedar Lake	Management Options and Sequencing	Pros	Cons
	Option 1: 1. Carp Study 2. External Watershed Treatments 3. Carp Harvesting 4. Sediment Phosphorus Inactivation 5. Curlyleaf Pondweed Management 1 & 2 completed concurrently	A carp study will help better define the problem and the possible management options; Scott WMO has a robust cost share program for watershed BMP project implementation; carp harvesting is popular and would reduce internal loading; sediment inactivation will reduce internal loading; management of curlyleaf pondweed may allow for native plant re-colonization	Carp control is still an emerging science; harvesting may have to be done multiple times; sediment phosphorus inactivation is expensive and is generally less effective in shallow lakes (although dosing methods have improved); curlyleaf pondweed seed bank may be substantial and management will likely require multi-year efforts
	Option 2: 1. Aquatic Plant Management Plan 2. External Watershed Treatments 3. Curlyleaf Pondweed 4. Carp Management 5. Sediment Phosphorus Inactivation 1,2,3,4 concurrently, with 5 completed in 5 to 10 years depending on results of other efforts	An aquatic plant management plan will help better define the problem and the possible management options; Scott Scott WMO has a robust cost share program for watershed BMP project implementation; carp harvesting is popular and would reduce internal loading; sediment inactivation will reduce internal loading; management of curlyleaf pondweed may allow for native plant re-colonization; delaying aggressive carp management will allow time for science to improve management options	Same as above
	Option 3: 1. Drawdown Lake 2. External Watershed Treatments 3. Sediment Treatment	Management of carp and curlyleaf pondweed may be simultaneously managed with lake drawdown; Scott WMO has a robust cost share program for watershed BMP project implementation; sediment inactivation will reduce internal loading; lower cost	Lake drawdown is not favored by the public or the LID; lake may not refill within one year; native plant seed bank may be insufficient for re-colonization
	Option 4: Do Nothing	Wouldn't cost the WMO or lake residents any money	Would not satisfy the TMDL requirements for the MPCA and EPA to bring the lake back to its ecoregion water quality standard; current degraded condition continues; also may not be socially acceptable by LID and lake residents

Table 4-5.McMahon Lake phosphorus reduction management options and sequencing

McMahon Lake (Carl's Lake)	Management Options and Sequencing	Pros	Cons
	Option 1: 1. Aquatic Plant Management Plan 2. Sediment Phosphorus Inactivation 3. Curlyleaf Pondweed Management 4. Monitor Eurasian watermilfoil	Plan would document what plant management methods may be used and how to prevent an increase in Eurasian watermilfoil; sediment treatment would make water clarity better; curlyleaf treatment could bring back native plants	McMahon is a Natural Environment Lake which MDNR does not allow chemical treatment of aquatic plants[1]; increase in water clarity and management of curlyleaf pondweed may promote growth of Eurasian watermilfoil
	Option 2: 1. External Watershed Treatments 2. Observe in-lake reaction	WMO has a robust cost share program for watershed treatments.	A lot of unknowns with the presence of Eurasian watermilfoil; only limited improvement likely, or may still have continued slow degradation
	Option 3: Do Nothing	Wouldn't cost the WMO or lake residents any money	Would not satisfy the TMDL requirements for the MPCA and EPA to bring the lake back to its ecoregion water quality standard; current degraded condition continues; also may not be socially acceptable by sportsman group and lake residents

[1]MDNR has indicated a willingness to consider allowing chemical treatment if part of an overall comprehensive improvement program.

Option 2 consisting of*:*

1. Completion of an Aquatic Plant Management Plan
2. External Watershed Treatments
3. Curlyleaf Pondweed
4. Carp Management
5. Sediment Phosphorus Inactivation;

where items 1, 2, 3, and 4 are completed concurrently, with #5 completed in 5 to 10 years depending on results of other efforts, appears to have the broadest base of support for Cedar Lake. Carp management in item 4 refers to subsidizing commercial harvesting for a few years while waiting for some of the existing studies by others to be completed. A small amount may be spent on additional study if the local sponsors can be convinced that the results will significantly improve the harvesting efforts.

For McMahon Lake there does not appear to be consensus. Option 3 to do nothing is not acceptable with local land owners and does not meet Clean Water Act objectives. Option 2 may not see much in the way of results since there is very little left in the watershed to treat. With Option 1 there are concerns about how the submerged aquatic plant community, particularly the Eurasian watermilfoil, will respond to increased water clarity, such that there would have to be a strong commitment to aquatic plant management following the sediment inactivation. In the end a sequence similar to that selected for Cedar Lake is being advanced where watershed treatments and aquatic plant management are initially advanced, with sediment inactivation considered in 5 to 10 years depending on the results of the other efforts. Stakeholders have, however, been informed that this approach may not show much in the way of results until the sediment treatment, since there is little left in the watershed to treat, and a variance would be needed to treat the curlyleaf pondweed and Eurasian water milfoil that infests the lake.

Section 5.0: Implementation Plan

This subsection describes the efforts already completed as well as those selected as future actions of the Implementation Plan. A summary of the Plan actions is presented in Table 5-1. Other actions in addition to the external and internal source reduction actions include: 1) administration, education and outreach, 2) technical assistance to land owners, and 3) monitoring. Detailed descriptions of external and internal source reduction actions are presented as are implementation costs, funding considerations, and responsibilities. Monitoring is described in more detail in Section 6.

The Plan is organized into subsections separately detailing external versus internal source reduction actions. Each subsection starts with an overview and a description of actions already completed. Completed actions are important to consider and document since the baseline year from which load reductions are determined is 2008, and a number of actions have been completed since that time.

5.1 External (Watershed) Source Reduction Plan Actions.

This subsection describes options already completed as well as those selected to be promoted as future actions in the Implementation Plan. The 25% external load allocation reductions needed for the two lakes are 82 lbs/yr and 17 lbs/yr during the growing season for Cedar and McMahon Lakes respectively, according to the NCHF calculations. Phosphorus reduction estimates for some of the practices are presented in the descriptions of the options in Section 4 and are tabulated in the following subsection.

Table 5-1. Implementation Plan Summary

Action	Responsible Parties	Schedule	Cost Considerations
External (Watershed) Source Reduction Actions			
Land Management Practices – Promoted through the Scott WMO, Scott SWCD and Rice SWCD programs	Scott WMO, Scott SWCD, Rice SWCD, NRCS	Annually with docket and program priorities reconsidered on an annual basis.	Scott WMO has a cost share program watershed-wide, of which the Cedar and McMahon Lake watersheds are only a small fraction. The program is funded by local levy at about $200,000/year. The WMO also currently has grants that double this amount for the next couple of years. Rice SWCD is able to promote NRCS and State cost share programs, and has access to a limited amount of USEPA 319 funds through the Scott WMO. Additional funding is needed to make meaningful land management changes in the TMDL watersheds while continuing to meeting other obligations.
Targeted Projects - Cedar Lake Farm Regional Park shoreland restoration and stabilization, conversion of cropland to native vegetation, and treatment practices West Cedar Lake subwatershed, additional targeted practices identified by the Scott SWCD, and the Scott WMO	Scott WMO, County Parks, and Scott SWCD	WMO Plan amendment in 2010 and 2012, Shoreland Implementation 2011 and 2012,West Cedar Lake subwatershed practices 2013 and 2014	Scott WMO completed a Plan Amendment in 2010, and has approved budgets for 2011 and 2012 with $100,000 for the shoreline improvement. An additional $100,000 has been secured by Great River Greening from LCCMR. The Scott WMO will also complete a Plan Amendment in 2012 adding the West Subwatershed Practices to its CIP list, and will apply for Clean Water Funds in 2012 to assist with the cost. The Scott SWCD will be completing a rural watershed assessment in 2012 focusing on Cedar Lake direct subwatershed to identify additional targeted efforts. Cost for this assessment is covered by the Scott WMO and a Clean Water Fund Grant.
Land Use Plan Implementation	Scott County	On-going	Cost internalized to Scott County for regulating and permitting
Internal Source Reduction Actions			
Aquatic Plant Management Plans	MDNR, Cedar LID, Scott WMO, New Market Sportsman Club, Lakeshore residents	Cedar Lake (dependent on pilot project) McMahon Lake 2012	Cedar Lake planning lead by MDNR; McMahon Lake estimated cost of $8,000.
Aquatic Plant Management	MDNR, Cedar LID Scott WMO, New Market Sportsman Club, Lakeshore residents	Annually per approved plan • Cedar Lake staring in 2013 • McMahon Lake	Cedar Lake - $40,000 to $50,000 per year for about 5 years decreasing after that, but still on-going. An unsuccessful Clean Water Fund grant application was submitted for a pilot effort in 2011for treatment in 2012. Local sponsors will continue to pursue grant funding.

		starting in 2013	McMahon Lake - $17,000 to $20,000 per year for about 5 years decreasing after that, but still on-going.
Rough Fish Control – Cedar Lake	MDNR, Cedar LID, Scott WMO	Annually for three years starting in 2012, then monitor	$7,500 to $15,000 per year
Inactivation of Sediment Phosphorus	To be determined	Earliest for Cedar Lakeis 2016 depending on success of other efforts Earliest for McMahon in 2014 depending on success of other efforts	Cedar Lake - $525,000[1] McMahon Lake - $87,600[1]
		Other Actions	
Administration and Education/Outreach	Scott WMO lead with Scott SWCD assistance	Annually	Estimated at approximately 10% of other program actions, except for alum treatment for which administrative costs are included in the estimate for the action.
Technical Assistance	Scott SWCD and Rice SWCD	Annually	Estimated at 20% of land management practice activity cost. Scott WMO currently funds technical assistance efforts for the WMO's cost share and incentive program. However expanded efforts will require additional funding for technical assistance at both SWCDs.
Monitoring	Scott WMO and volunteers	Annually with one year of supplemental data collection	Scott WMO currently sponsors volunteer monitoring through the Metropolitan Council CAMP program. This will continue. In addition it is anticipated that one year out of every five will also include at a minimum supplemental data collection involving an aquatic plant survey, dissolved oxygen profiles, and additional sampling and analysis for dissolved phosphorus. For more on monitoring see report Section 5.

[1]Treatment may need to be repeated in 5 to 10 years.

It should be noted that there is significant uncertainty in the reduction calculations. The estimated reductions are at the field edge and not necessarily what's delivered to the lakes, and the targeted lake reductions are for the growing season while the practice reductions are for the entire year. This means that much more needs to be implemented than just the sum of the individual practices, and it emphasizes the need for an adaptive approach. Because of these uncertainties, target amounts for individual practices were selected that appear to exceed the Cedar Lake growing season target reductions.

For McMahon Lake there is only a limited amount of watershed treatment available. The native grass project already approved is expected to reduce phosphorus by 6.9 lbs/yr, and conversion of the remaining 46 acres to native grass has a reduction benefit of about 16 lb/yr. There is also the one uncompleted shoreland stabilization project. It is unlikely that land owners will be willing to do all of this, but the 46 acres and the shoreland project were selected as implementation targets.

5.1.1 Completed Watershed Actions. A number of practices have been completed in the watersheds of the two lakes in recent years through various programs (Table 5-2). Of most interest is the completion of shoreland stabilization/restoration projects with land owners around Cedar and McMahon Lakes through the Scott WMO cost share and incentive program; and the recent seeding of 20 acres of native grasses on the north side of McMahon Lake through the MNDNR Working Lands Initiative. It is also important to recall (as described in Section 4) that there are some historic actions prior to 2008 that have also reduced external loads. The most significant historic actions include:

1. Installation of sewer around the lake in 2001, and
2. Reduction of flows from the diversion over time.

Table 5-2. Watershed Actions Completed Since 2008

Location	Description	Estimated Phosphorus Reduction lbs/year
Cedar Lake		
Diversion Watershed	Sticka Native Grasses	7.4
Diversion Watershed	Sandin Natives Grasses	10.3
Direct Watershed	Grote and Besser Shoreland Stabilizations	8 6
Direct Watershed	3-4 Small Shoreline Restorations	NA[1]
McMahon Lake		
Direct Watershed	Lapenski Native Grasses	6.9 (5.3[2])
Direct Watershed	Bowers Shoreline Stabilization	15

[1]Estimates not available
[2]Estimate using the BWSR calculator

5.1.2 Future Watershed Actions.

Future actions consist of:

1. Targeting and promoting Land Management BMPs through the Scott WMO cost share and incentive program, and through the Rice SWCD
2. Implementation of specific targeted practices
3. On-going management of the land development/conversion process.

Details of each action are described below. Additional targeted Land Management BMPs and/or targeted Capital Projects may be added to the Plan. The Scott SWCD through the Metro Conservation Districts was awarded access to a Clean Water Fund Grant for a rural Subwatershed Analysis. The Scott WMO has requested that this analysis be completed for the direct Cedar Lake subwatershed. The assessment will be completed in 2012. It is expected to identify where additional practices should be targeted.

Most of the future actions are already included in the Scott WMO Comprehensive Water Resources Management Plan. The exceptions are the West Cedar Lake subwatershed practices. These will be added as an amendment in 2012. Other projects can be added through additional future amendments, or if eligible be completed as part of the Scott WMO Technical Assistance and Cost Share (TACS) program. Estimated phosphorus reductions from the known future actions are summarized in Table 5-3.

Table 5-3. Estimated Phosphorus Reductions from Future Watershed Actions

Implementation Element	Location	Description	Estimated Phosphorus Reduction lbs/year
Cedar Lake			
Land Management Practices	Both Direct and Diversion Watershed	Multiple eligible practices	Depends on number of participating land owners
	Diversion Watershed	Rice County Wetland Restoration	153[1]
Targeted Projects	Cedar Lake Direct Watershed	Shoreland stabilization at Cedar Lake Farms Regional Park	11
	Cedar Lake Direct Watershed (West Subwatershed)	Water quality practices (biocells and filterstrips)	35
	Cedar Lake Direct Watershed	Shoreline restoration at Cedar Lake Farms Regional Park	Unknown but anticipated to be moderate
	Cedar Lake Direct Watershed	Native Plantings at Cedar Lake Farms Regional Park	8.2
McMahon			
Land Management Practices	Direct Watershed	Multiple eligible practices	Depends on number of participating land owners
Applicable to Both Lakes			
Land Use Plan Implementation	Direct and Indirect Watersheds	Standards for stormwater management applied with development, or negotiation of Planned Urban Development with Incentives	Standards and incentives are expected to mitigate water quality impacts where the existing land use is grassland or forest; are expected to reduce phosphorus export 40 to 60% where existing use is row crop agriculture

[1] Reduction to the lake will be only a fraction of the estimate since only a fraction of the flow in the tributary is diverted to the lake.

Land Management Practices. The Scott WMO TACS program was established together with the Scott SWCD in 2005. The goal of the program is to help improve water quality. Through the cooperation of local, State, and Federal agencies, landowners, and municipalities are eligible for programs that provide educational, technical, and financial assistance to execute various conservation practices. In addition the Rice SWCD promotes BMPs, particularly through NRCS programs and certain practices are eligible for USEPA 319 grant funding. Table 5-4 describes varies levels of practice advancement discussed by local organizations.

The full suite of agricultural BMPs will be passively promoted as Level 2 in Table 5-4 (i.e., water and sediment basins, grade control, grassed waterways, conservation tillage, nutrient management, wetland restoration, alternative tile intakes, terraces, critical area plantings, diversions). Other practices will be advanced as shown in Table 5-5. Scott WMO has already selected its target areas for 2012. Areas identified in Table 5-5 will be considered for targeting in 2012 and 2013.

There is one 17 acre wetland restoration with a 9.4 acre buffer currently in process for the NRCS WREP program as discussed in Section 4. It is estimated that this practice should be completed in 2013, with an estimated phosphorus reduction of about 153 lbs/year to the Sand Creek tributary. The reduction to Cedar Lake will be much less since only a fraction of the flow in the tributary is diverted.

Table 5-4. Local Levels of Practice Advancement

Local Units	Level 1: Not Advanced	Level 2: Passively Promoted	Level 3: Actively Promote	Level 4: Area Targeting	Level 5: Specific Target
Scott County, Scott WMO, Scott SWCD	Will not actively pursue	Will assist NRCS with EQIP, CRP, WRP, and USFWS with applicable programs, and State cost share and incentive program, will include in WMO cost share and incentive docket, will consider and score applications, and seek additional grant funding.	Level 2 plus will advocate for NRCS to include as an annual priority, may consider more active advertising, and will provide bonus points to cost share and incentive scoring applications	Level 3 plus will contact property owners in a specific target area	Level 4 plus will contact property owner to promote a project at a specific location, and will consider Scott WMO targeted project funds
Rice County, Rice SWCD	Will not actively pursue	Will assist NRCS with EQIP, CRP, WRP, and USFWS with applicable programs, and State cost share and incentive program; and will pursue additional grant funding.	Level 2 plus will advocate for NRCS to include as an annual priority	Level 3 plus will contact property owners in a specific area	Level 4 plus will contact property owner to promote a project at a specific location

Table 5-5. Selected Levels of Land Management Practice Advancement

Practice	Local Partner	Level	Target Area	Cost Share or Incentive[1]
Shoreland Stabilization or Restoration	Scott WMO, Scott SWCD	Level 4: Area Targeting	Shoreline of Cedar and McMahon Lakes using shoreland surveys and landowner workshops	75% of cost estimate (stabilization); 50% of cost estimate (restoration)
Filter Strips	Rice SWCD	Level 5: Specific Target	Wheatland Township Section 4 (medium priority)	Through CRP program and at CRP rates[2]. Harvestable filters same as Scott WMO below.
Filter Strips	Scott WMO, Scott SWCD	Level 5: Specific Target	Cedar Lake Township Sections 29, 30 and 32 (high priority)	Non-harvestable - $250/ac/year Harvestable: Natives- $200/ac/year plus 75% of cost estimate Harvestable: non-natives - $200/ac/year
Native Grass	Scott WMO, Scott SWCD, and Rice SWCD[3]	Level 4: Area Targeting	Areas with cropped HEL, and areas in Natural Area Corridors (high priority in direct watersheds, medium in diversion watershed)	$125/ac/year to $200/ac/year; plus 50% to 100% of cost estimate
Riparian Forest Buffer	Scott WMO, Scott SWCD	Level 3: Actively Promoted	Along channel in the diversion watershed	75% of cost estimate
Wetland Restoration	Rice SWCD, and Scott SWCD	Level 3: Actively Promoted	Diversion watershed to Cedar Lake	Completed through the NRCS WREP Program. An additional bonus of up to $500/acre is available for applications in 2012[4]

[1]The Scott WMO's cost share and incentive program docket is reviewed and updated annually. Values presented reflect the 2012 docket.
[2]Rates similar to Scott WMO rates would attract more participation, but ability to offer higher rates is dependent on availability of grants.
[3]Currently possible through a Clean Water Fund Grant to the Scott WMO from BWSR. Future capacity for Rice SWCD to promote is dependent on funding.
[4]Bonus is possible through a Clean Water Fund Grant to the Scott WMO from BWSR.

Targeted Projects. A number of specific targeted watershed projects were identified as part of the study. These are assessed in Section 4 with several surviving the assessment and incorporated into the Implementation Plan. Two of these are already completed (i.e., Lapenski Native Grasses and Bower Shoreline stabilization) for McMahon Lake as described in subsection 5.1.1 above. An additional stabilization identified on McMahon Lake is rather small and could be handled through the Scott WMO cost share program. The land owner has been contacted.

Shoreline restoration and shoreline stabilization projects were also identified at Cedar Lake Farm Regional Park. Funding has been obtained for both projects and they are scheduled to be completed by the end of 2013.

Water quality practices in the west Cedar Lake subwatershed were also assessed in Section 4 and advanced for implementation. These include biocells and filter strips as shown in Figure 4-2. Estimated construction cost is $81,000 with phosphorus removal estimated at 35 lbs/year. Engineering, administration and construction supervision will add another 20% to 25% for a total cost of around $100,000. The Scott WMO anticipates initiating engineering design early 2012, applying for Clean Water Funding September 2012, with construction of the practices in 2013 and 2014 depending on the success of the grant.

The Scott WMO and Scott County Parks are also targeting water quality improvement to be made with development of Cedar Lake Farms Regional Park. The recently completed Master Plan anticipates approximately 23 acres of the park currently in active use area or cropland that drains to the lake to be converted over to native plant communities. As discussed in Section 4 this could reduce phosphorus loading about 8.2 lbs/year. Depending on whether this conversion occurs as forest or grassland the cost would range from $16,330 to $23,000 if all 23 acres are converted. It is anticipated that the first areas to be restored are those surrounding the West Cedar Lake subwatershed practices. This area will be restored at the same time the practices are installed.

Implementation of the Scott County 2030 Comprehensive Land Use Plan Update and Detailed Area Plan. As discussed in Section 4, it is expected that implementation of the Scott County 2030 Comprehensive Land Use Plan and Detailed Area Plan will slowly improve water quality. This action consists of implementing and promoting the Comp Plan, enforcing local ordinances, and promoting the PUD public values portions of the Plan that create incentives for Natural Areas Corridors protection, wetland restoration and low impact development.

5.2 Internal Source Load Reduction Plan Actions

For the purposes of completing this Implementation Plan, Cedar Lake internal source control Option 2 and McMahon Lake Option 1 were detailed for implementation. If initial treatment of McMahon sediment inactivation is not approved for permitting or if funding is not found, the implemented option simply becomes Option 2. The following provides a description of the internal source control elements already completed as well as those selected to be promoted as future actions in the Implementation Plan.

5.2.1 Completed Internal Source Control Actions.

Internal Phosphorus Loading Study. Sediment phosphorus composition and potential internal phosphorus loading from the sediment was assessed through sediment phosphorus analysis and modeling in 2007. This study is included as Appendix B of the TMDL study (BARR, 2012).

Macrophyte Surveys in Cedar and McMahon Lakes. The community composition and coverage of native and invasive aquatic plants in Cedar and

McMahon Lakes were completed through macrophyte surveys conducted in 2007. The MDNR also completed a survey of Cedar Lake in 2009. Scott WMO anticipates completing an updated survey of McMahon Lake in 2012 as part of developing an Aquatic Plant Management Plan.

5.2.2 Future Internal Source Control Actions.

Aquatic Plant Management Plan Development. Preliminary assessments of the aquatic plant communities, as stated above, have been completed by the Scott WMO. However, before the MDNR will issue a permit for large scale treatment of lakes for curlyleaf pondweed, an aquatic plant management plan, developed in conjunction with MDNR, is required. These plans detail the current status of the macrophyte community along with specific treatment objectives and activities. For both lakes, goals and actions will need to be established for improving the native plant community via reduction of invasive species. MDNR has indicated a willingness to lead the development of an Aquatic Plant Management Plan for Cedar Lake starting the fall of 2010. Changes in staff at the MDNR have caused a delay in starting the APMP. As soon as that position is filled the Scott WMO will work with the MDNR to complete an APMP. MDNR has indicated that a pilot effort targeting the northeast bay could be started without a whole lake plan on Cedar Lake since the acreage targeted for the pilot effort (approx. 100 acres) is within that allowed for treatment without a plan. Scott WMO has budgeted for the completion of a plan for McMahon Lake in 2012.

Aquatic Plant Management to Control Curlyleaf Pondweed. Curlyleaf pondweed populations will be managed to limit internal phosphorus loading from plant die back during the growing season. This will be accomplished through methods included in the approved Aquatic Plant Management Plans. Although for Cedar Lake a pilot treatment project focusing on the northeast bay of the lake will be completed first and monitored to determine if native plants re-establish before proceeding to a whole lake effort. The Plan for McMahon Lake will also include considerations for preventing the spread of Eurasian watermilfoil. It is expected that these efforts could start in 2013. Scott WMO will cost share up to $15,000/year for treatment on Cedar Lake. Since McMahon is a Natural Environment Lake Scott WMO cost share would be decided as a special case.

Roughfish Control. In the short term commercial harvesting will be subsidized to increase harvesting of both carp and black bullheads in Cedar Lake. The first year of implementation will be targeted for 2012. A long term strategy will also be considered as more information on carp management is developed. The first step of this strategy is to meet with Peter Sorensen of the University of Minnesota to discuss the complex issue of roughfish control and his research and how to approach the problem on a watershed basis.

Inactivation of Sediment Phosphorus. Sediment phosphorus inactivation will be targeted for both lakes. Implementation will be dependent on funding. The Scott WMO will consider including portions of the cost as a targeted project. However, the WMO does expect partnerships to be formed to share the cost. To add a targeted project to the Scott WMO Plan the WMO will need to amend its Comprehensive Water Resources Management Plan. The WMO will start such an amendment in the fall of 2010 with target dates for treatment of 2014 for McMahon Lake, and 2016 for Cedar Lake. These dates may change depending on the success of other actions.

5.3 Other Activities

5.3.1 Education And Outreach. The Scott WMO anticipates providing education and outreach efforts. These include:

- Articles in the bi-monthly County newspaper called the SCENE

- Public/open house meetings as needed to complete the Aquatic Plant Management Plans, and discuss planned actions (particularly the alum treatments) before they are completed
- Workshops/information promoting shoreland management, shoreland stabilization and restoration, yard care for clean water, cost share program

5.4 Implementation Costs

Estimated costs to achieve the TMDL vary by lake and will likely change over time as curlyleaf dominance is decreased. It is expected that there will be some on-going cost for aquatic plant management following initial treatments, and it's uncertain whether one or two alum treatments will be needed. Timing of the alum treatment may also change. In particular it may be 10 years before experts feel curlyleaf and carp populations in Cedar Lake have been reduced enough to make the investment in the alum treatment. For now, two alum treatments were assumed at 5 year increments, and costs were developed for 5-year increments. Estimates are presented in Tables 5-6 and 5-7 for Cedar and McMahon Lakes, respectively. This incremental approach allows for scheduled evaluation and course corrections during the 5th year. For Cedar Lake the estimated cost is from $1,390,000 to $2,430,000; and for McMahon the cost range is from $271,100 to $456,100. The total cost for implementation of the projects described in this TMDL report is expected to range from $1,661,100 to $2,891,100 (2010 dollars). The range in cost is primarily due to the uncertainty of whether one or two sediment treatments will be needed, and what methods and management duration will be required to manage curlyleaf pondweed.

Table 5-6. Cedar Lake Implementation Cost Estimate, 2010 Dollars

Activity	Cost	Frequency	5-year Total Range	
			Low	High
Initial 5 Years				
Land Management - Technical Assistance and Cost Share Program with land owners[1]	$5,000 to $40,000	Annually	$ 25,000	$ 200,000
Targeted Watershed Project - Shoreline stabilization at Cedar Lake Farm[2]	$8,000 to $15,000	1 time	$ 8,000	$ 15,000
Targeted Watershed Project - Shoreline restoration at Cedar Lake Farm[3]	$200,000	1 time	$ 200,000	$ 200,000
Targeted Watershed Project - Native vegetation at Cedar Lake Fram	$16,330 to $23,000	1 time	$ 81,650	$ 115,000
Targeted Watershed Project - West Cedar Subwatershed BMPs	$100,000	1 time	$ 100,000	$ 100,000
Aquatic Plant Management	$40,000	Annually	$ 200,000	$ 200,000
Rough Fish Harvesting	$15,000 to $20,000	Annually	$ 75,000	$ 100,000
Alum Treatment	$525,000	1 time	$ 525,000	$ 525,000
Administration and Education/outreach	$5,000 to $10,000	Annually	$ 25,000	$ 50,000
Technical Assistance	$2,000 to $6,000	Annually	$ 10,000	$ 30,000
Monitoring[4]	$600 to $9,500	Annually plus special	$ 6,500	$ 12,500
Total Initial 5 Years			**$ 1,256,150**	**$ 1,547,500**
Second 5 Years				
Land Management - Technical Assistance and Cost Share Program with land owners[1]	$5,000 to $20,000	Annually	$ 25,000	$ 100,000
Aquatic Plant Management	$10,000 to $30,000	Annually	$ 50,000	$ 150,000
Rough Fish Harvesting	$15,000 to $20,000	Bi -annually	$ 30,000	$ 40,000
Alum Treatment	$525,000	If necessary 1 time	$ -	$ 525,000
Administration and Education/outreach	$3,000 to $7,000	Annually	$ 15,000	$ 35,000
Technical Assistance	$1,500 to $4,000	Annually	$ 7,500	$ 20,000
Monitoring[4]	$600 to $9,600	Annually	$ 6,500	$ 12,500
Total for Second 5 Years			**$ 134,000**	**$ 882,500**
10 Year Total			**$ 1,390,150**	**$ 2,430,000**

[1]Scott WMO budgets approx $200,000 annually for the TACS program WMO wide, additional grrant funds for selected practices also available for 2012 and 213

[2]Funding already in place from Clean Water Fund Grant and the Scott WMO

[3]Funding in place from Scott WMO and LCCMR

[4]Low estimate includes $600 annually for CAMP Voluneer efforts plus one macrophyte survey, High estimate includes $600 annually for CAMP Volunteer efforts plus additional chemical analyses, and several macrophyte surveys.

Table 5-7. McMahon Lake Implementation Cost Estimate, 2010 Dollars

Activity	Cost	Frequency	5-year Total Range	
			Low	High
Initial 5 Years				
Land Management - Technical Assistance and Cost Share Program with land owners[1]	$5,000 to $10,000	Annually	$ 25,000	$ 50,000
Aquatic Plant Management Plan	$8,000	1 time	$ 8,000	$ 8,000
Aquatic Plant Management	$17,000 to $20,000	Annually	$ 85,000	$ 100,000
Alum Treatment	$87,600	1 time	$ 87,600	$ 87,600
Administration and Education/outreach	$2,400	Annually	$ 12,000	$ 12,000
Technical Assistance	$1,600.0	Annually	$ 8,000	$ 8,000
Monitoring[2]	$600 to $2,500	Annually plus special	$ 5,500	$ 5,500
Total Initial 5 Years			**$ 231,100**	**$ 271,100**
Second 5 Years				
Land Management - Technical Assistance and Cost Share Program with land owners[1]	$1,600 to $7,000	Annually	$ 8,000	$ 35,000
Aquatic Plant Management	$3,500 to $10,000	Annually	$ 19,500	$ 50,000
Alum Treatment	$87,600	If necessary 1 time	$ -	$ 87,600
Administration and Education/outreach	$1,200	Annually	$ 6,000	$ 6,000
Monitoring[3]	$600 to $3,500	Annually plus special	$ 6,500	$ 6,500
Total for Second 5 Years			**$ 40,000**	**$ 185,100**
10 Year Total			**$ 271,100**	**$ 456,200**

[1]Scott WMO budgets approx $200,000 annually for the TACS program WMO wide, additional grrant funds for selected practices also available for 2012 and 213

[2]Includes $600 annually for CAMP Voluneer efforts plus one macrophyte survey,

[3]Includes $600 annually for CAMP Volunteer efforts plus additional chemical analyses and one macrophyte survey

5.5 Responsible Parties

The Scott WMO will initially take the lead role in implementing external (watershed) source reductions to achieve the LA defined in this TMDL. The Scott WMO will also assist with and help enable completion of the internal source reduction efforts consistent with the goals and policies of the Scott WMO as articulated in its approved Comprehensive Water Resources Management Plan. Particular goals and policies affecting responsibilities and participation of the WMO are summarized in Table 5-8. These goals, policies and strategies were developed by the WMO recognizing that the WMO is not the only organization with responsibility for water management. It is a shared responsibility between State and local government and the public. Others parties and their responsibilities include:

- The Cedar Lake Improvement District is currently evaluating and deciding their role, but will be a partner on different projects within this plan.
- The New Prague Sportsman Club will be responsible for continued operation of the winter aerator on Cedar Lake.
- The Minnesota Department of Natural Resources will be responsible for technical assistance on lake management and fisheries management issues, leading the development of an Aquatic Plant Management Plan for Cedar Lake, and for permitting aquatic plant management efforts.
- The Minnesota Pollution Control Agency who will be responsible for technical assistance on water quality management issues, assisting with implementation funding, and permitting of the alum treatments.
- The Rice SWCD who will pursue grant funding for filter strips together with the Scott SWCD and the Scott WMO, and will promote filter strips in the Rice County portion of the diversion watershed to Cedar Lake.
- The Scott SWCD who will pursue grant funding for filter strips, native grasses and shoreline stabilization/restoration with the Scott WMO, and will promote and target these practices in the watersheds to the lakes.
- Watershed residents and lakeshore owners who will participate in programs and practices for appropriate stewardship on their property.

The New Market Sportsman's Club will continue to operate the winter aerator and is currently considering other roles they might plan with McMahon Lake (Carl's Lake) management efforts.

Table 5-8. Goals, Policies and Strategies Defining Scott WMO Roles for TMDL Implementation

Goal	Policy and Strategy	Interpretation for This Implementation Plan
Goal 2: Surface Water Quality. To Protect and Improve Surface Water Quality	Policy 2.1: Promote a Sustainable System of Buffers and Green Infrastructure Strategy 2.1.2: Promoting Disconnected Stormwater Management and Low Impact Development Strategy 1.3.3: Promote Public Values Incentive Program Strategy 2.1.3: Support Detailed Area Planning	The Scott WMO through the County permitting program will work to implement its standards such that the land use transition planned for this area occurs in a way that improves water quality.
	Policy 2.3: Address Impaired Waters and Improve Water Quality Strategy 2.3.1: Cost Share Program for Existing Land Uses	The WMO will promote targeted land management practices in the lake watersheds. However, the WMO levy amount planned into the future is not adequate to cover all of the implementation needs to meet these TMDLs and other obligations of the WMO.
	Policy 2.3: Address Impaired Waters and Improve Water Quality Strategy 2.3.2: Targeted Project Implementation and Capital Improvements	The WMO will consider plan amendments to implement both watershed and in-lake actions. The amount the WMO could consider for targeted projects ranges from $50,000 to $100,000 per year without significantly impacting other goals for other water bodies and programs.
	Policy 2.3: Address Impaired Waters and Improve Water Quality Strategy 2.3.3: Technical Assistance	Fund staff time at the Scott SWCD to have technical assistance available for land owners participating in the cost share and incentive program.
	Strategy 2.3.4 Promote and Enable Curly Leaf Pondweed Control	The WMO will encourage the development of Aquatic Plant Management Plans and treatment of curlyleaf pondweed by matching planning costs at 50% up to $5,000; and treatment costs up to $2,500/year.
	Policy 2.4: Improve Understanding of Water Quality Strategy 2.4.1: Complete Diagnostic Studies/TMDLs Leading to Targeted Implementation and Monitoring Strategy 2.4.2: Monitoring and Assessment Tools Development	The WMO will continue to support volunteer based citizen monitoring of the lakes and the collection of additional data as needed to make informed decisions and adapt.
Goal 7: Optimize	Policy 7.6: Regularly Assess Programs and Progress	The WMO will embrace the adaptive management

Public Expenditures	Strategy 7.6.1: Periodic Assessments and Program Reviews Strategy 7.6.2: Use Long Term and Short Term Metrics to Measure Progress	approach and will lead annual progress evaluations.
	Policy 7.7: Promote Equitable Distribution of Project and Program Cost Strategy 7.7.1: Expect Local and Land Owner Participation	The WMO will expect other local units of government and land owners to share in the installation cost of land management practices.
	Policy 7.7: Promote Equitable Distribution of Project and Program Costs Strategy 7.7.3: Tax/Assess Affected Parties for Larger Capital Improvement Projects	The WMO will consider a special assessment to fund portions of the large cost items on the Implementation Plan. However, it is unlikely that the WMO will consider an assessment to cover the entire cost of large items since the affected areas are unincorporated with only a modest tax capacity, and the improvements would benefit more than just the local residents.
	Policy 7.7: Promote Equitable Distribution of Project and Program Costs Strategy 7.7.4: Share Costs with LGUs for Projects with Inter-jurisdictional Benefits	The WMO will consider sharing the cost of capital improvements with other LGUs, particularly the Cedar Lake Improvement District according to the criteria in the WMO Plan considering the relative benefit to residents of the WMO and the Cedar LID.
	Policy 7.8: Engage Volunteers Strategy 5.2.1: Volunteer Monitors	The WMO will continue to sponsor the volunteer monitors for the two lakes.

Section 6.0: Monitoring Plan to Track Implementation Effectiveness

The water quality in Cedar and McMahon Lakes has been monitored for over 30 years, and will continue to be monitored for the foreseeable future. The Scott WMO will continue to monitor the water quality in the lakes periodically through the CAMP program. The typical lake sampling protocol is to visit the lakes 8 to 10 times between April and September. The following water quality parameters are measured at each visit during intensively monitored years (about every 5^{th} year). All parameters except Secchi disc and chlorophyll *a* are measured at various depths in the water column (every 1 to 2 meters.)

- Secchi disc
- Dissolved Oxygen (during intensive monitoring years)
- Temperature
- Total Phosphorus
- Chlorophyll *a*

It will also be important to monitor the long-term effectiveness of any water quality improvement projects being constructed in either the Cedar Lake or McMahon Lake watersheds. Documentation of installed BMPs and testing of removal efficiencies of representative phosphorus reduction BMPs will be conducted, where possible. Comprehensive phytoplankton, zooplankton, macrophyte and fisheries surveys will be conducted in both lake basins during at least one of the years that surface water quality monitoring is conducted.

The comparison between future monitoring data and the modeling results in this study can be conducted as follows:

1. Using monitoring results (flow and water quality sampling data), calculate the annual load (or the load over some other time period) of phosphorus leaving the basins.

2. Run the in-lake models for same time period and calculate the load that the model predicts for pre-project conditions.
3. Compare the two loads, and calculate the percent reduction that was achieved over the time period of interest.

Section 7.0: References

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